THE

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	Page
The London County Council: The Question at Issue	129
Tramcar Brakes	130
Smoke Nuisance	130
Steam Boiler Inspection in the United States	131
Hard-Drawn Copper Wire (*illus.*)	131
Correspondence:—	
Shift Engineers	134
Side-Street Lighting	134
Metallic Filament Lamps	134
Jerry Wiring	135
The Penetrating Properties of the Arc Light	135
Technical Literature	136
Tramway Lifeguards	136
Searchlights in the Navy	136
Wireless Telegraphy and the Admiralty Contract ...	136
Appointment of Electrical Engineer	136
London County Council Electric Power Supply Bill (1907) ...	137
New Electrical Devices, Fittings, and Plant (*illus.*)	138
Legal	139
Business Notes	139
Prof. A. Schuster, Sc.D., Ph.D., F.R.S. (*illus.*)	147
Electrically-Operated Sinking Plant (*illus.*)	148
Electrical Clock and Telegraph Installation at the Liverpool Cotton Exchange (*illus.*)	151
Notes	152
City Notes	156
Market Quotations	158
Stocks and Shares	158
Share List of Electrical Companies	159
Exports and Imports of Electrical Goods during Dec., 1906	161
Notes on the Evolution of Canal Electrification Methods	162
Proceedings of Institutions:—New Incandescent Lamps ...	165
New Patents Applied For	168
Published Specifications	168

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(J. A. BERLY'S).

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THE LONDON COUNTY COUNCIL: THE QUESTION AT ISSUE.

AT election times the conflict of parties creates useful discussion, and the process of educating the public in the facts and principles involved, grows apace. It is a pity that the controversy is not always carried on without abuse (which is no argument), or without misstatements which, when rectified, recoil upon those who make them.

There appears to us to be, in the present contest, too much of the policy recommended in the instruction to Counsel, "No case; abuse plaintiffs' attorney."

The Progressive party make the tramways the main, if not the only question at issue, and in doing so call those who prefer private enterprise to municipal trading in such matters, by all sorts of names, such as "Trusts," "Octopus," "Monopolists," intended to influence the voter, while the other side fling back the terrible word "Tammany," with all it is supposed to cover.

In the days of Dan O'Connell, some of the hard words in Euclid were used by him with effect upon the ignorant multitude, and, perhaps, if a private company were called an "isosceles triangle," it would gain some coveted votes.

Amid the din of the disputants, a few facts may be extracted with advantage. The apologists of the Council claim that on the working of the tramways they have realised £293,592 in relief of rates, and refer to the accounts, from which it appears that the "surplus balance" derived from the Northern system, amounted to £314,851, or considerably more than all the profit disposed of: the Council, in fact, received this handsome sum in the shape of "Out-door relief" from the hands of the successful "Octopus," whose real name was the North Metropolitan Tramways Co.

The general public will have some difficulty in grasping the accounts of the L.C.C. The Finance Committee inform the Council that it is necessary to bear in mind the significance of the terms "surplus balance" and "deficiency balance," which, they say, do not correspond with the commercial terms "profit and loss." We have previously noticed that words assume curiously unfamiliar meanings when applied to their enterprises by municipal authorities.

These subtleties of accountancy would not make popular electioneering leaflets, so that the voter is appealed to on the simpler issue of tramways or no tramways—although no such question is involved—the real question being as to how they shall be provided: by private enterprise, or by municipal trading.

During the last 10 days or so the daily Press has been publishing some very slashing criticisms of the tramway policy of the L.C.C. and its finance. The *Standard* has in one of its articles made charges of such a character regarding the tramway contracts, &c., that 12 members of the High-

ways Committee have commenced a libel action against that journal. As we have said already, there are hard things said on both sides at election times, and while we do not pretend here to discuss the *Standard's* points *ad seriatim*, we may be allowed to remark that if writs had been served in connection with all the slanderous "progressive" speeches concerning electric "trusts" and private companies, the Courts might have had to sit on through a Long Vacation. When hard things are said against men sitting as members of the Highways Committee "steps" are taken, but is it not forgotten that there are gentlemen in connection with private companies whose reputations have been besmeared in a very callous fashion by municipal trading advocates? The *Standard's* articles are being run for electoral purposes no doubt. Is the serving of this present writ merely a counter electoral move?

The tramways, however, are already with us; and the really practical questions for the electors are concerned with the further action of the Council in the direction of trading in electricity supply. It by no means follows that, because 6 per cent. has been made on the capital invested, mainly out of the profit derived from the company on leased lines, a similar result will follow, now that the working is a municipal speculation, and it may still be a question whether the leasing system may not be reverted to with advantage to the ratepayers.

The new adventures proposed by the L.C.C. have a very practical bearing, and should be carefully scrutinised by the electors, especially the electric power scheme for supplying London, which involves enormous risks and responsibilities. One of the favourite arguments put forward for this promotion is that some day, if it is left in the hands of the companies, a second edition of the water monopoly purchase may arise, but there is really no analogy between them. In the first place, water is an absolute necessity for every individual inhabitant, whereas electricity, with all its advantages, has not been adopted for either light or power by more than a mere fraction of the population, the bulk of them doing without it, although, to those who know, it is so obviously in their interest to make use of it.

Then there is no monopoly—for companies compete with one another, even in the same streets—and the prices charged are constantly on the down grade, instead of being a fixed high rate maintained under the action of a monopoly.

Apart altogether from the question of municipal trading, it is most undesirable to confer upon the L.C.C. such a monopoly, for what they aim at is the ultimate supply of all London, including portions of Essex, Kent, Surrey and Middlesex. It is proposed to take over almost all the electrical undertakings at present carried on by the London Borough Councils, besides obtaining ultimately those of the private companies, and so to constitute a huge monopoly.

When that was accomplished a time might come when the L.C.C., being controlled by a party desirous of further relieving the rates, by raising their prices for electricity, could impose any terms they pleased.

There is no evidence that under County Council management the public would be better served than by the companies, who understand the business, and trade with their own money; on the contrary, with a changing Council, unfamiliar with the highly technical business, and trading upon borrowed capital returnable at fixed dates, the chances are that the results would resemble those of the ill-omened steamboat service.

Tramcar Brakes.

A POSITIVE good invariably springs from an ill thing. The Highgate runaway, and the others that clustered round it, killed and maimed a deplorable number of people, but they spurred the brains of that section of the noble army of inventors which concerns itself with tramway kinks, with the result that several brakes which cannot fail, so we are told, have appeared on paper or in practice some months or years earlier than they would have appeared had there been no accidents.

Last week we reported the successful trial of Mr. Freund's spring power track brake, which, in being readily controlled, marks a decided advance for the type. This week we are glad to announce that the combined mechanical and magnetic track brake, which Mr. Fell foreshadowed during the B. of T. inquiry into the circumstances of the Highgate accident, has been produced, and is being tried on two L.C.C. cars. This is due, we understand, to the B.T.-H. Co., in consultation, no doubt, with Mr. Fell, and the whole tramway world will await the results of these trials with great interest.

Having once overcome the inherent obstacles in the way of attaching a comparatively rigid system of levers to the almost freely floating magnetic shoes, the advantages of the new combination are obvious. It is said that the same leverage is obtained as with the ordinary mechanical slipper, so that the mechanical and magnetic effects when superimposed must be much more powerful.

The two functions of the brake are independent of each other, so that the failure of one does not affect the other.

The designers suggest that the magnetic function should be utilised for speed regulation and service stops on the level, and presumably on slight inclines, but that on more dangerous inclines the present practice of stopping the car on the brow, and applying the track brake mechanically, should continue in force. That is advisable, in our opinion, for two reasons, the chief being that, in case of a failure of the magnetic force in the middle of a steep hill, the car might gather such speed before the driver could bring the mechanical force into action, that no leverage at his command would serve to stay it; and the other is that it is undesirable to alter radically the habits of the drivers.

Our objection to relying on a mechanically operated slipper brake for stopping or even for slowing up a car which has begun to run away—*i.e.*, has reached a speed in excess of 8 to 10 miles per hour, on a really dangerous grade, of which there are plenty of instances on British tramways, may not be well founded, but there is in tramway circles the same feeling of uncertainty, and this will not be dispelled until a series of tests at high speeds on grades of 1 in 8 to 1 in 16 have brought out the track brake triumphant.

We must admit that the same remarks can be, and are, applied to the magnetic brake in a lesser degree, and by fewer competent critics, but our hope is that Mr. Fell will take care to make the tests sufficiently stringent and exhaustive so that they may throw much light on these matters.

We do not propose at this moment to investigate the question as to whether the new brake fills the requirements which we ventured to lay down recently in a leading article.

It is *àpropos* to remark that the B. of T. have not consented, as was rumoured, to appoint a Departmental Committee on Brakes, but we are informed by the Tramways and Light Railways Association that the Board are willing to nominate a representative to sit with any Committee which may be appointed jointly by the T. and L.R.A. and the M.T.A.

Smoke Nuisance.

THE case of Davies *v.* The Rock House Hotel Co., which was heard by Mr. Justice Neville on January 17th, and is reported in another column of this issue, raised certain points which are of some interest to those who are concerned with the private supply of electricity. It serves to illustrate the fact that a man may not lay down and work a plant without due regard to the comfort of his neighbours. The action was brought to restrain a nuisance caused by smoke, which was caused by a small installation at Llandrindod Wells. The plaintiff complained that "blacks" and "noisome" fumes were emitted from one of the defendants' chimneys, with the result that, at certain hours of the day, his house

wae rendered practically uninhabitable. The defendants' case was that the evidence on behalf of the plaintiff was grossly exaggerated. The engine, it appeared, had been running for some ten years. It was a 7-H.P. engine with a vertical boiler 6 ft. × 3 ft.—quite a toy plant, in fact. A good class of Welsh steam coal was used. In the result, however, the Court held that the plaintiff had made out his case, and granted an injunction.

We have no reason to doubt that the decision was correct, and the case would in all probability have been decided in a similar way if the supply in question had been granted by a statutory company, for, as our readers are aware, they are not exempt from action for nuisance. At the same time, we think the time has arrived when some relief should be given to those who, in generating electricity, must of necessity occasion a certain amount of annoyance to their neighbours. It was long ago laid down that if railway trains occasion annoyance to dwellers near the line, the company are exempt from action for nuisance, inasmuch as a certain amount of discomfort is the necessary concomitant of ordinary railway practice. So with the supply of electricity. If the supply company can prove that it has taken all reasonable precautions to prevent nuisance, it should be absolved from actions at law, upon the principle that the interests of the many—namely, the consumers—are to be considered before those of the few who happen to live in the neighbourhood.

Steam Boiler Inspection in the United States.

In an article on boiler insurance in *Insurance Engineering*, Mr. L. B. Brainerd, the president of the Hartford Boiler Insurance Co., gives some interesting figures *re* boiler insurance, specially with regard to the statistics of his own company which is by far the largest of the boiler insurance companies in America, insuring as it does 91,727 boilers, as against 51,850 insured by the other 10 companies together. The total premiums, if all the other companies charge the same rates as the Hartford Co., were in 1905 about £384,513, of which sum the Hartford Co. received £245,645. The 10 smaller companies averaged each 5,185 boilers under their care, one having only 283, and the largest company nearly 25,000. The actual figures for the 10 smaller companies are not known, but those of the Hartford Co. are correct.

Some people accuse the Hartford Co. of wasting money on excessive inspection. This is hardly a fault in boiler inspection; and we happen to know that the ruling spirits of the company do really endeavour to put boiler inspection, working and construction on a sound basis. In the United States it is by no means all pleasure to endeavour to cut down the working pressures there allowed by law. These pressures are in excess of safety as much as our English pressures are held by some to be wastefully small. But to cut down working pressure is always an invidious task.

The Hartford Co. was not founded until 1866, so that it has made rapid growth. In 1905 it condemned 753 boilers as unfit for further use, discovered 155,024 defects, of which 14,209 were considered vital, and made 291,041 inspections, or 929 for each working day. This amounts to three inspections or thereabouts per boiler per annum, and every inspection is made by a salaried employé of the company.

Safety has always been the goal kept in view. It appears that expenses consume half the premium income, and losses take another 9 per cent., leaving about 40 per cent. for reserve and profit, which latter has averaged 7·86 per cent. only during five years, 1901-5, or if applied on the per boiler basis, the profit has been only about 4s. 6d. per boiler per annum, not a large sum in profit for undertaking so much arduous labour and taking so much risk. The Hartford Co. confines its work to steam boilers only, and therefore does even a more restricted business than our English companies, for these insure and inspect engines and even electrical plant. There is, indeed, no more creditable institution in the United States than the Hartford Boiler Insurance Co.

HARD-DRAWN COPPER WIRE.

By THOMAS BOLTON.

The value of copper wire of which the tensile strength has been raised by drawing has long been recognised by electrical engineers for all purposes where it is convenient to carry a conductor overhead, but there does not appear to have been any very precise study by them of its properties. A complete specification was drawn up by the Post Office engineers many years ago for those sizes of wire which they found most convenient for telegraph and telephone lines, and this specification has been found to meet the case excellently for those particular sizes, and has become the standard practically all over the world. This specification only covers wires of comparatively thin gauges, while at the present time there are many different specifications in use for the thick sizes used as trolley wire in electric traction, and for power transmission and similar purposes there is really no specification that is generally recognised.

In order to acquire some data which might assist towards the framing of a standard specification for all sizes, a number of tests have been recently carried out by Mr. M. A. Bolton at the Oakamoor Works of Thomas Bolton & Sons, Ltd., and through the courtesy of Prof. Hopkinson in the Engineering Laboratory, Cambridge, and perhaps some account from a practical point of view of the results obtained may be of general interest.

The Engineering Standards Committee in their report issued a short time back defined hard-drawn copper wire as that which will not elongate more than 1 per cent. without fracture. Unfortunately, this definition, although probably correct as broadly representing the material under the conditions under which it is used, has caused considerable misapprehension, being quite inapplicable to conditions of practical testing with ordinary appliances. In the case of soft copper wire under stress a steady permanent elongation takes place as the load is increased, practically throughout all the length of the piece under test until the breaking point is reached, when a local elongation takes place just at the spot where the wire breaks. The total elongation being large this local elongation is small in proportion, and so the result is not materially affected by the length of the test piece. With hard-drawn wire, however, the actual increase of length while under stress is small until the point of fracture is reached, when a local elongation takes place as described above, which forms a large part of the total. Consequently if elongation is measured up to actual fracture the percentage depends, through this cause alone, largely on the length of the test piece. Further, the test pieces ordinarily employed are not more than 8 or 10 in. long, and the total elongation to be measured being very small indeed, there is little doubt that although fairly uniform measurements are obtained, the readings are largely affected by unavoidable sources of error, and are a good deal higher than they should be, since it has been found that very much smaller figures are obtained by careful experiment upon pieces many feet in length.

The Standards Committee's definition makes no mention of the length of the test piece, and without this it cannot be taken in the light of a specification with which hard-drawn copper wire will comply under ordinary conditions of testing with test pieces of moderate length, while under such conditions any such wire of good quality *will* show more than 1 per cent. elongation before fracture. A difficulty in the way of any such general definition is that what is true of one size of wire is not true of another. What effect exactly the process of drawing has upon copper it would require a series of experiments of another nature to determine, but the effect appears to be twofold, viz., to increase the tensile strength and to increase the elasticity. The latter effect is almost nullified by subsequent annealing, and the former partially so. The action appears to be to some extent superficial, as the effect is less on a wire of large diameter than on one of small diameter whose area is, of course, smaller in proportion to surface. This is shown by fig. 1, in which the ordinates are tons per square inch of area and the abscissæ elongation per cent. in 10 in. The two curves show the behaviour under stress of a wire of ·064 in.

diameter and one of ·128 in. diameter, drawn without annealing to such an extent as to effect the same proportionate reduction of area in each case. If, therefore, all sizes of copper wire were prepared with the same proportional

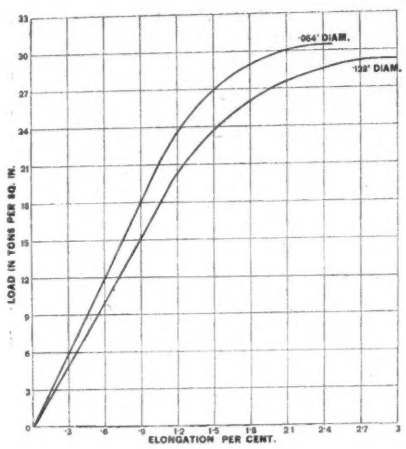

Fig. 1.

amount of hard-drawing, their properties would still be different. In practice, however, the difference is magnified to a slight extent by economic reasons. For instance, supposing a wire $\frac{1}{16}$ in. diameter to be drawn from a rolled rod $\frac{1}{4}$ in. diameter, it would be necessary to draw a $\frac{3}{8}$-in. trolley wire from a rod $1\frac{1}{2}$ in. diameter in order to give it the same proportional reduction of area. Naturally to do this would require the employment of very heavy drawing machinery, and the cost of the process would be very considerable. It is customary, therefore, to draw each size of wire to such an extent as shall give ample strength for

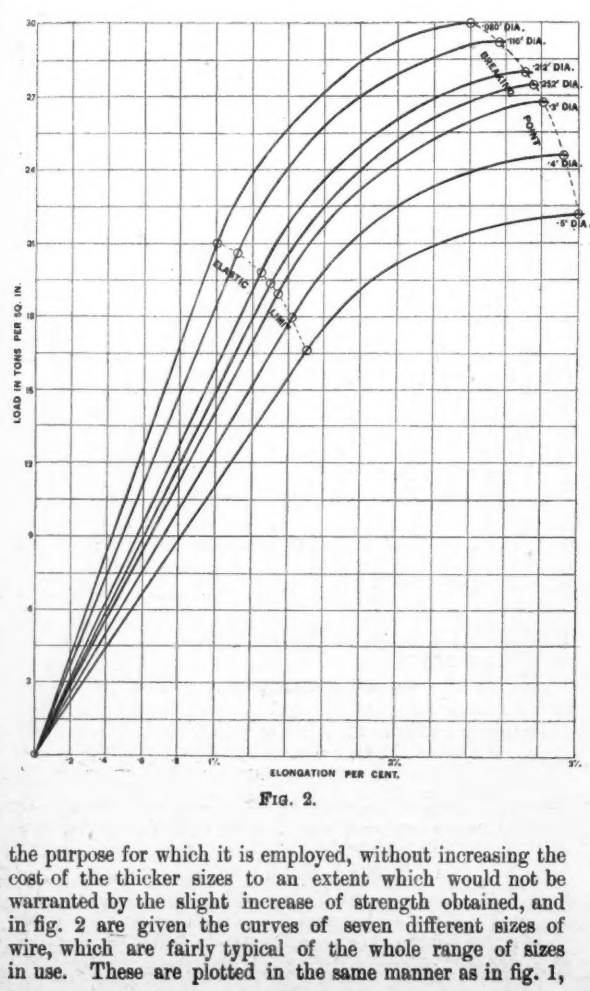

Fig. 2.

the purpose for which it is employed, without increasing the cost of the thicker sizes to an extent which would not be warranted by the slight increase of strength obtained, and in fig. 2 are given the curves of seven different sizes of wire, which are fairly typical of the whole range of sizes in use. These are plotted in the same manner as in fig. 1, from the average results obtained with ordinary testing apparatus from a large number of tests of wires of the respective sizes, made from electrolytic copper of 100 per cent. conductivity and upwards, and prepared in the manner which is considered to give the best results at reasonable cost. A glance at this diagram gives a fair idea of the gradual alteration in the behaviour of wires under tensile stress between the limits of size used for overhead work. It will be seen that while at No. 14 S.W.G. (·080 in. diameter) an ultimate strength of 30 tons per square inch is reached, that of No. 7/0 S.W.G. (·5 in. diameter) is only 22·4 tons, the elongation at fracture rising from 2·2 per cent. in 10 in. on the first named to 3 per cent. on the latter. The elastic limit follows the breaking stress in a fairly constant ratio, being reached on the thinnest wire in the series at 70 per cent. of the breaking stress and at 75 per cent. on the thickest, while it is at about 42 per cent. and 50 per cent. respectively of the ultimate strain; the greater proportional elasticity of the thicker wire apparently being due to the fact that elasticity is almost entirely dependent on "temper" as the result of hard drawing, whereas tensile strength is only partially so, being a property also of annealed copper, which, beginning in the original casting, is increased by elongation of the fibre both in roll-

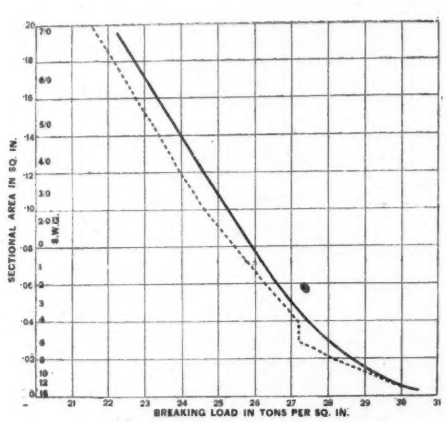

Fig. 3.

ing and in drawing. The modulus of elasticity works out at about 4,700,000 for the ·080 in. wire, and about 2,500,000 for that of ·5 in. diameter, but these figures cannot be taken as representative of the material, although they show the results likely to be obtained in practice with ordinary short test pieces. The figures given for copper in the text-books are from 15,000,000 to 16,000,000, and a careful test on a sample of hard-drawn wire about $\frac{1}{16}$ in. diameter and 15 ft. long has given a little over 17,000,000. The great divergence between this and the above figures arises from the difference in the reading obtained for elongation in the latter case, owing to the much greater length of test piece, in proportion to which the sources of error become comparatively small.

As it is impracticable to get anything like true figures without specially designed experiments, it seems undesirable to embody the modulus of elasticity in any working specification.

The essential difference between hard-drawn and soft copper wire is in elasticity, and it would appear that if a short definition of the former is wanted in order to point this distinction, it can be best described as copper wire, of which the elastic limit under tensile stress is not less than 60 per cent. (or 70 per cent.) of the breaking load. For the purpose, however, of a specification which engineers may insist upon as governing supplies, it does not seem practicable to devise any general definition, and it is necessary to employ a table that shall specify the properties of each size of wire, while for convenience this must be based on properties which can be easily and quickly tested with apparatus practicable in a factory. The inaccuracy of the figures ordinarily obtained for elongation seems to render them unsuitable to form part of a specification, and although for purposes of comparison only they are fairly reliable, and it may be thought desirable to specify a certain approximate elongation

S.W.G.	Diameter. Inches.	Area. Square inches.	Weight per mile. Lb.	Breaking stress.		Approximate elastic limit.		Approximate elongation per cent. in 10 in.		Resistance at 60° F. Ohms per mile.	Variation in diameter. + or −
				Load in lb.	Tons per square inch.	Load in lb.	Tons per square inch.	At breaking load.	At elastic limit.		
7/0	·5	·19635	3,993	9,500	21·6	7,125	16·2	·3	1·5	·2197	·005
6/0	·464	·1·909	3,439	8,480	22·4	6,285	16·6	3	1·5	·2551	·005
A. 4/0	·460	·16619	3,380	8,370	22·5	6,215	16·7	3	1·5	·2596	·005
5/0	·432	·14657	2,981	7,680	23·2	5,550	16·9	3	1·5	·2943	·0045
A. 3/0	·4096	·13179	2,680	6,970	23·6	5,135	17·4	2·9	1·4	·3273	·0045
4/0	·4	·12566	2,555	6,470	23·8	4,925	17·5	2·9	1·4	·3433	·004
3/0	·372	·10868	2,210	5,920	24·3	4,285	17·6	2·9	1·4	·3968	·004
A. 2/0	·3648	·10452	2,126	5,740	24·5	4,140	17·7	2·9	1·4	·4127	·004
2/0	·348	·09512	1,934	5,280	24·8	3,790	17·8	2·8	1·4	·4534	·004
A. 0	·3249	·08293	1,687	4,700	25·3	3,340	18	2·8	1·4	·5201	·004
0	·324	·08245	1,677	4,670	25·3	3,320	18	2·8	1·4	·5232	·004
1	·3	·07068	1,438	4,080	25·8	2,865	18·1	2·8	1·3	·6103	·0035
A. 1	·2893	·06573	1,337	3,830	26·0	2,680	18·2	2·7	1·3	·6562	·003
2	·276	·05983	1,217	3,520	26·3	2,460	18·3	2·7	1·3	·7209	·003
3	·252	·04987	1,014	2,980	26·7	2,085	18·5	2·7	1·3	·8649	·003
4	·232	·04227	859·7	2,560	27·0	1,790	18·8	2·7	1·3	1·0205	·0025
G.P.O.	·2237	·03931	800	2,400	27·2	1,680	19	2·7	1·3	1·0981	·0022
5	·212	·03530	717·9	2,150	27·2	1,505	19	2·7	1·2	1·222	·0021
G.P.O.	·1937	·02948	600	1,800	27·2	1,260	19	2·7	1·2	1·4642	·0019
6	·192	·02895	588·8	1,760	27·2	1,230	19	2·6	1·2	1·49	·0019
7	·176	·02433	494·7	1,500	27·6	1,050	19·3	2·6	1·2	1·773	·0018
8	·160	·02011	408·9	1,260	28·0	880	19·6	2·6	1·2	2·145	·0016
G.P.O.	·1582	·01966	400	1,250	28·2	875	19·7	2·6	1·2	2·1962	·0016
9	·144	·01629	331·2	1,040	28·6	730	20	2·6	1·2	2·648	·0015
G.P.O.	·137	·01474	300	950	28·8	665	20·2	2·5	1·1	2·9283	·0014
10	·128	·01287	261·7	830	29·0	580	20·3	2·5	1·1	3·352	·0013
11	·116	·01057	215	695	29·4	485	20·6	2·5	1·1	4·081	·0012
G.P.O.	·1119	·00983	200	650	29·5	455	20·6	2·5	1·1	4·3925	·0012
12	·104	·00849	172·75	560	29·6	390	20·7	2·5	1·1	5·081	·001
G.P.O.	·0969	·00737	150	490	29·7	340	20·8	2·4	1	5·856	·001
13	·092	·00665	135·18	440	29·8	310	20·8	2·4	1	6·487	·0009
14	·080	·00503	102·22	335	29·9	235	20·9	2·4	1	8·575	·0008
G.P.O.	·0791	·00491	100	330	30	230	21	2·4	1	8·785	·0008
15	·072	·00407	82·8	270	30	190	21	2·3	1	10·599	·0007
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16	·064	·00322	65·41	220	30·5	150	21	2·2	1	13·397	·0007
17	·056	·00246	50·09	168	30·5	115	21	—	—	17·534	·0006
18	·048	·00181	36·8	124	30·5	85	21	—	—	23·831	·0005
19	·040	·00126	25·55	86	30·5	59	21	—	—	34·234	·0004
20	·036	·00102	20·7	70	30·5	48	21	—	—	42·289	·0004

before fracture or under a specified load (this being understood to be under ordinary conditions and the length of test piece being given), we fall back on the breaking stress as affording the most convenient and reliable basis on which to frame a specification for general use.

In preference to a test for elongation, the writer would place a most excellent condition contained in the Post Office specification for overhead line wires, viz., "That all wire shall stand wrapping in six turns round its own diameter, unwrapping and wrapping again in the same direction without fracture." This, if coupled with the requirement of a sufficient tensile strength, ensures wire of the best possible quality for all overhead purposes, which also will be found to have the other properties described.

It remains now to define what the tensile strength of each size of wire should be, and for the reasons already stated, we can only employ empirical figures deduced from actual experience of manufacture. An attempt has been made in fig. 3 to show graphically the variation in the strength through the whole range of sizes employed, the ordinates here representing sectional area and the abscissæ the corresponding strength per unit of area; the full line is plotted from the average values obtained from a large number of tests of wires of the best electrolytic copper.

It will be noticed that through the thicker gauges the strength varies in a simple proportion, while as the thinner sizes are reached the increase in strength is more rapid.

The dotted line shows the minimum strengths suggested for a working specification. This follows the experimental line with a margin of about ½ ton per square inch from ·2 to ·1 sq. in. area, and from that point gradually approaches it except for a divergence to embrace the G.P.O. specification; the latter, though not quite in proportion to the natural strengths, having worked so well in practice and being so well known, that it would be unnecessary, as well as almost an impertinence, to suggest any alteration in it.

In conclusion, a table is appended giving for all gauges properties which it is considered that engineers may reasonably insist upon as a minimum governing their supplies, and it is suggested that of these the figures for tensile stress alone be taken for testing purposes, coupled with the Post Office wrapping test described above, and, if desired, with the approximate elongations specified. The figures are given for the standard diameter for each gauge, while in the last column are given the maximum variations in diameter above or below the standard that may reasonably be claimed by, and are usually allowed to, manufacturers. To correct the specification for any actual sample of wire falling within the limits of the variation allowed, is, of course, a simple matter of calculation. The sizes for which no number in the S.W.G. are given are those adopted by the G.P.O. for line wires, and the main figures for them are taken from the G.P.O. specification. The numbers marked A are Browne & Sharpe or American gauge, which is used in this country to some extent in connection with trolley wire.

Callender's Hospital Fund.—We have before us a copy of the fourth annual report and accounts of the Hospital and Distress Fund, which is a very worthy and most successful feature of the Belvedere (Kent) works of Callender's Cable and Construction Co., Ltd. The total funds subscribed (including £50 from the company and various personal donations from the directors) amounted to £274, £204 representing members' subscriptions of 1d. a week. The year was one of exceptional distress among the members caused chiefly by lack of employment, and 90 urgent cases were helped at a cost of £154 11s., compared with only £57 10s. expended in the same direction in the preceding year. The grants made to hospitals and convalescent homes represented £208 odd, as against £234 in the preceding year.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Shift Engineers.

In your correspondence *re* shift engineers there is a class of young gentlemen that has not—very naturally—been considered, but whose case might, I think, bear being put forward. I refer to the many to whom a premiumed apprenticeship is impossible, equally also their being kept away from home while serving in works at a low wage for some years; the towns they happen to live in being small and minus works.

Take the actual case of a youth who had to forego his intended apprenticeship, he, although starting late, spent two years in electric installation work because he could not obtain another berth sooner; then had one year in small workshops, gaining, however, be it noted, a thoroughly sound mechanical experience through the variety of work he did (equal, perhaps, to two or three years' repetition work in large works). There were no evening classes handy, so he studied alone, to good advantage. During all this time he tried hard to get a berth in a lighting station as anything at 15s. per week, but to no purpose. At last a friend obtained for him an interview with an engineer, he was taken on trial, proved easily equal to the work, and was given a sub-station attendant's birth, which he has held for over six months, and now wants to be moving forward.

This is the main point. What chance has he of obtaining a berth at a central station (say at 25s. per week—just enough to keep himself on, which is now imperative) to qualify for a shift engineer?

He answers dozens of advertisements, but his experience—on paper—does not look flowery enough in comparison, and the engineer picking out the best paper experience very likely gets hold of a young "My Lord Pupil," who has sauntered through between lathes and dynamos, and glared at instruments on switchboards for a certain number of years without any interest whatever (mind you, my ideas are not necessarily cramped on this point; it is simply a possible case). If each chief, when choosing a few applicants for interviews (say for the post of assistant shift engineer) would give one "Nondescript," such as is here described, a chance to see him, is it not possible that he might find one who would be of as much, perhaps more, value to him after, say, two, or perhaps three, weeks when he had gripped hold of and settled into the work, than the aforementioned uninterested one.

Taking even an undistorted view of the case, it seems a little hard that eager, quick and capable young men who have their way to make in the profession (in contradistinction to many to whom a money-earning capacity is not of such vital importance) should have to wear themselves with anxiety and lose years of the most valuable time of their lives in vainly endeavouring to burst through this barrier that is keeping them from their ambitions. There are not a few of such, and I feel sure that a good many engineers, if they only thought a little what an assistant shift engineer's berth would mean to one of these nondescript applicants, would stretch out a helping hand and give a man who really needs it a chance.

I am aware that this may have a wrong construction put upon it, but space does not permit of its being enlarged upon, and, maybe, tempered by more justifiable reasons; but I only hope and trust that some may interpret its true meaning and bearing, and that it may benefit even only one capable aspirant.

One Who Storms.

London, *January* 18*th*, 1907.

I was very much struck, "not hard," by the remark of Mr. Milnes when he says that positions are not obtained by personal influence to-day; he admits thereby that such has been done, yes, and it is done to-day, and I have read in your paper articles complaining of the same. I should not like to trouble Mr. Milnes with the names of, say, a dozen stations where this influence is absent, but half the number would suffice. I can tell him of a certain station where 75 per cent. of the people in it have obtained their positions through personal influence. Huge charity organisations are Corporation works, let Mr. Milnes prove otherwise. Under these conditions, where is the chance for the learned, well-trained and experienced man? Under such conditions men must either exploit or be exploited, with the result that the profession degenerates, and it becomes a mere waste of money and time studying to become a shift engineer.

Shifto.

Side-Street Lighting.

I have read with interest the article on "Side-Street Lighting" by Mr. A. C. Hanson. I am surprised he has not mentioned the "Osram" lamps for side-street lighting, as I have found one of these 32-c.p. 110-volt lamps equal to the ordinary Welsbach incandescent mantle used for street lighting, and in several districts here I have substituted these for what formerly was lighted by gas, with considerable satisfaction.

The economy of the "Osram" lamp is undoubted, and it is quite possible with these lamps to compete with gas lighting.

In part of his article he mentions that before side-street lighting has been undertaken, mains have already been laid in the streets, and in such cases "the extra expense of the separate main might turn the scale in favour of incandescent gas."

I have not found this the case where a cheap and satisfactory form of time-switch can be used.

It is less trouble to the undertaking, without looking to the advertisement added, to make the connection to the original low tension distributor, thus avoiding the expense of a separate main, but returning all the same advantages.

The time-switch that is now used here, and which has proved satisfactory, is the one made by the Improved Electric Supplies, Ltd., and after trying nearly every other make I have come to the conclusion that it is essential, if reliability is desired, to use nothing but the first quality workmanship English-made clock by a firm of repute. It is true it adds slightly to the expense of the time-switch, but its action can then be relied upon.

I would like to caution any engineers who think that lead-covered rubber wire, from the distributor joint-box up to the post, would be satisfactory. This has been tried in many cases, and has generally failed after a few years' use, with the result that I have had to replace this lead-covered wire with the ordinary concentric lead twin armoured cable, and then I have had no trouble whatever.

Horace Boot,
Consulting Engineer and General Manager.

Tunbridge Wells Corporation
Electricity Works,
January 21*st*, 1907.

Metallic Filament Lamps.

Owing to the large number of speakers and short time for discussion, at the recent meetings of the Institution of Electrical Engineers, on the above paper, I had not the opportunity of giving my experiences as a contractor and large retailer of electric lamps. I venture to think, however, that they might prove sufficiently interesting to some of your readers to warrant your giving them some publicity, through the medium of your admirable Review.

I installed at a double-fronted shop, in one window, 24 16-c.p., carbon filament lamps, and in the other window, 8 50-c.p. Osram lamps (metal filaments). The supply was 100 volts 60 periods.

The Osram have now been in use about 500 hours, during which time they have consumed about 250 units, which at the price charged, 5d., amounts to £5 4s. 2d. Two lamps gave out in the first 150 hours, therefore, allowing for 10 lamps at 5s. each—£2 10s., we have a total cost of £7 14s. 2d. for energy and lamps.

The 24 Royal Ediswan lamps consumed 750 units, thus showing a cost, for current alone, of £15 12s. 6d. If I allow 24s. for the cost of these lamps, the total cost for these and the energy is £16 16s. 6d. (as against £7 14s. 2d., in the case of the Osram) showing an actual saving of no less than £9 2s. 4d.

Had the cost of the supply been 4d., 3d., or 1d. per unit, there would have been effected a saving of £7 0s. 8d., £4 19s. or 15s. 8d. respectively.

The Osram also had the advantage as regards quality of light. In the matter of candle-power, the Osram gave 400 as against the 384 of the Royal Ediswan. The latter, also, have all but ended their economical life. One of the Osrams requires renewing because it has blackened, but the rest appear as good as new.

I have found these new Osram lamps satisfactory, and consider the small 2 and 4-volt ones excellent.

The Tantalum lamps I have found also very good, when burnt on a direct current.

I believe we shall even yet see great improvements in incandescent electric lamps, and will give any new type a fair trial and accord the makers every encouragement.

R. N. Cunningham.

London, W., *January 21st*, 1907.

It does not seem to have occurred to your correspondent signing himself "'Appy 'Ampstead," that one reason why I put in six tantalum lamps into my house, which is on the Hampstead supply of alternating current, was precisely *because* I knew it was said that these lamps did not run well on alternating currents. I wanted, naturally, to find out whether the statement was true; and if true, why. Having tried, I know.

Silvanus P. Thompson.

London, E.C., *January 22nd*, 1907.

As there was not any opportunity to reply to several points raised by various members at the recent discussion at the Institution on Mr. Swinburne's paper on "Metallic Filament Lamps," I should be grateful if you would allow me this opportunity of commenting on the points raised.

I note that nearly every one who spoke discouragingly of the tantalum lamps has used them on alternating current in distinct opposition to the makers' recommendation. It is, therefore, scarcely surprising that the results they obtained were not encouraging. As one having had an experience extending over two years with the tantalum lamp, I beg to state that there is no doubt that the makers' claims are more than justified if the lamps are used under fair conditions. The "pairing" of the lamps is a matter of great importance, and when this is given proper attention and the lamps are installed of a voltage sufficiently high to cover the fluctuations of the supply (a fairly large order in some circumstances, Mr. Editor), the average useful life of the lamps on direct-current circuits comes out well above 750 hours with a reduction of not more than 25 per cent. to 30 per cent. in candle-power at the end of 1,000 hours.

With regard to the glare from high efficiency filaments mentioned by some gentlemen, this is a question of illumination by no means insurmountable if advantage is taken of holophane diffusing globes and reflectors (for which tantalum lamps are particularly suited owing to the locus of illumination being small and consequently focusable) now available, without appreciable reduction in efficiency.

I was interested to hear from the carbon filament lamp makers that there was nothing to prevent their placing a lamp (carbon filament) on the market of practically the same life and efficiency as tantalum. "Why don't they do it?"

There appeared to be an incubus of doubt as to the tantalum lamp being a commercial article. I find, on inquiring at the makers, that they are selling about 60,000 per month in this country, and could probably double this if they could obtain the lamps quicker.

Sparks.

London, S.W., *January 21st*, 1907.

Jerry Wiring.

I have recently had brought to my notice the installation of a lighting, bell and telephone system in a large building which, after some few months' working, developed a series of little troubles, such as failure of circuits, both lighting and telephone, and the continual running down of the bell and telephone batteries. On investigation, it was found that the screwed steel conduit which was used throughout the building had, in many places under the floors, been eaten away and the wires damaged, whether by electrolytic or chemical action the opinions of the several experts called in do not agree.

While looking into the matter myself, I found that the bell and telephone wires had been pulled into many of the conduit runs, and through the same joint-boxes as the lighting wires. This, to my mind, is an exceedingly bad and dangerous practice, and I should very much like to know your own, and any of your interested readers' opinions on this matter, and as to what is the likely cause of the trouble with the conduit.

The conduit was laid on the coke breeze floors throughout the building, and afterwards covered with a patent composition flooring. The supply to the building is taken from a company's mains, and is a continuous current 200-volt one.

Interested.

[Certainly it is highly improper to pull bell wires into conduits used for electric light wires. As for the corrosion of the conduit, it is impossible to form an opinion without inspecting the work.—Eds. E.R.]

I think it is high time that a little more attention was paid to the wiring of private and business houses supplied from public mains. I had occasion quite recently to test an installation of a private residence supplied from a public supply, and there found a pair of leads 7/22 supplying no fewer than 26 16-c.p. lamps, and under floors and such places that are concealed from the casual eye, wires were run quite without protection, and were simply cleated to the joist; and in some cases the cables were not braided. Now who is to blame for this? Is it the contractor, or is the engineer responsible?

While on a visit in the neighbourhood of Erith, Kent, I was attracted by the lighting of a business house in that neighbourhood, and there I found a fair specimen of what may be termed a scamped job; for quite exposed to public view were cables twisted round existing gas barrel, and pinched behind same without casing or tubing to protect them, and drawn from the casing to their respective lights, also without mechanical protection, and exposed to *public* view.

S. Fraser.

London, S.E., *January* 21st, 1907.

The Penetrating Properties of the Arc Light.

Mr. Bastian, in his reply to Mr. Dow's article on this subject, gave, as the reason of the sun's redness in a fog, an excess of red rays in that illuminant. He now refuses to see how ridiculous that theory is, so I will state the case as clearly as possible.

(*a*) The sunlight is white before it reaches the fog, as can be observed by anyone in clear air outside.

(*b*) Fog absorbs red light more than blue (according to Mr. Bastian).

(*c*) The white light after passing through Mr. Bastian's red-absorbing fog appears red to an observer in the fog.

I called this result "startling," but Mr. Bastian is unable to see it, and so, of course, is unable to see that an excess of red light in the illuminant does not explain it. As regards the tiny particles in the atmosphere and modern microscopes, I would remind Mr. Bastian that a depth of a mile at least is in general required before any blue colour can be noticed, and I would rather engage to find the proverbial needle in the haystack than try to capture particles comparable in size to the wave-length of violet light with a modern high-power microscope. Mr. Dow was wise in refusing to discuss the subject further with Mr. Bastian, and I now see

that no advantage can accrue to your readers from this correspondence being carried to any greater length, especially as I am not so fortunate as to be interested in the development of a lamp rich in red rays.

Sol.

York, *January 21st*, 1907.

Technical Literature.

I do not often trouble you with a letter, and this shall not be a long one. I have just read "W. M. M.'s" article in your current number, and feel I *must* write to say ditto, ditto, ditto, and as many times more ditto as you will print. The article ought to be printed in letters of gold and distributed all over the civilised world. The amount of utterly useless matter printed, is nothing short of criminal; the effect is to render it impossible for a busy man to read anything.

C. H. W.

London, *January 21st*, 1907.

Tramway Lifeguards.

Referring to Mr. P. J. Pringle's letter on the above subject, although I have not previously heard of an accident similar to the one quoted, I appreciate the possibility of such a thing happening.

I notice Mr. Pringle suggests the fitting of a third or even fourth additional strip on the hanging gate. I have for some time had three strips of wood fixed on these gates, but have had considerable trouble from wind resistance. In windy weather the gates have been constantly operated by the wind, and the guards dropped. I think in place of wooden strips on these gates, an iron framework covered with substantial wire netting is the correct solution of the difficulty.

A. R. Dayson,
General Manager.

Corporation Tramways, Sunderland,
January 19th, 1907.

Searchlights in the Navy.

Referring to your correspondent's inquiry in your issue of 11th inst., *re* first searchlight in H.M. Navy—the first searchlight was placed on board H.M.S. *Comet* (torpedo boat) at Portsmouth, March, 1874.

W. H. F.

Wireless Telegraphy and the Admiralty Contract.

It is difficult to believe that "Your Correspondent" is as ignorant and foolish as apparently he would have us think, and, in view of his declaration that the Admiralty confirms his statement, one inclines to accept the other alternative commonly presented for consideration in cases such as this. I will, however, for the moment, give him the benefit of the doubt, although I fear that, by refusing to admit the proof of his mis-statements, he will show that I have been too charitable.

As "Your Correspondent" gracefully observes, the officials of the Admiralty are not fools, and the public are not fools; but it seems clear that his intelligence must be rated greatly below that of the general public. It is foolish to contradict a statement made by one party to an agreement which cannot be, and is not, denied by the other; it is particularly foolish under the circumstances in question.

The Parliamentary Return to which "Your Correspondent" refers purports to be, and, to the best of my knowledge, is, the agreement between the Admiralty and Marconi's Wireless Telegraph Co., Ltd., dated July 24th, 1903. "Your Correspondent" stated that the Admiralty "is not compelled to purchase any more apparatus from that company except jiggers and trays of Leyden jars." This statement I denied. The obligations of the Admiralty towards our company need not necessarily have been defined by this agreement, nor did the Parliamentary Return state them to be defined by it. The Admiralty might have made with our company half-a-dozen contracts since the contract of July, 1903, but if that contract be assumed to govern the situation, it in itself suggests to a person of average intelligence that the schedule originally agreed to may have been extended. Provision for its extension is clearly made in Clause 5, subsection *c*, which "Your Correspondent" ought to have realised even before he made his alleged reference to the Admiralty. That clause provides for the Admiralty purchasing exclusively from the Marconi Co. the articles mentioned in the schedule *or any other articles which might afterwards be agreed to be treated as included in the schedule.* Other apparatus has been agreed to be treated as included in the schedule, and the Admiralty is under contractual obligation to purchase only from the Marconi Co. apparatus other than the articles quoted by "Your Correspondent," and has bought some thousands of pounds' worth of this other apparatus from the company, which it is, and was at the time it made the purchases, under contractual obligation to purchase from no one else.

When "Your Correspondent" made his original statement he wrote with reprehensible inaccuracy. When, after my denial of it, he repeated it, his action deserved condemnation in severer terms. In writing that his assertion had been "confirmed by inquiry of a person in authority in the Admiralty," he laid himself open to serious consequences.

Your readers must not be misled by his suggestion that the attention of the Lords of the Admiralty should be drawn to my statement, for I say unhesitatingly, over my own signature, that if the attention of the Lords of the Admiralty is drawn to my statement they will find that it is correct.

I would, however, say to "Your Correspondent" that it is perhaps undesirable for a Civil servant, who is breaking one of the rules of the service, to press for inquiries of this character.

I now await "Your Correspondent's" retractation and apologies; but I fear, having regard to his attitude towards other mis-statements of his which I have exposed and disproved, I am likely to wait a long time for the *amende honorable.*

It is under circumstances such as these that the advantage of anonymity is seen—an advantage from which, however, no self-respecting person cares to benefit. "Your Correspondent" reminds me of the man in *Punch*, who, when chased under the bed by his wife with a poker, declares, "You cannot break my manly spirit; I won't come out."

Marconi's Wireless Telegraph Co., Ltd.
H. Cuthbert Hall,
Managing Director.

London, E.C., *January 22nd*, 1907.

Appointment of Electrical Engineer.

I thought, perhaps, you might be interested in the enclosed form, for the appointment of "chief electrical engineer" at Tonbridge, at the princely salary of £150 per annum. If you read the form through, you will see that they want a Lord Kelvin, together with the ghost of Prof. Kennedy thrown in.

I draw your attention to this matter, as I think it is most discouraging when applying for a post of such responsibility to get a paper like this.

Another Chief.

Extracts from the form:—

Candidates must not be less than 25 or more than 40 years of age, must have had a thorough training as mechanical and electrical engineers in some recognised works, and have had experience with the low-pressure three-wire direct-current system, high-speed engines, accumulators and triple-concentric cables. They must also be competent to design and supervise extensions of plant and mains, and to draft the necessary specifications, plans and estimates.

The engineer appointed must agree to devote the whole of his time to the service of the Council; but will have the privilege of having one pupil at a time.

The gentleman appointed will have control under the direction of the Electric Lighting Committee of the electricity supply undertaking, and the administrative departments connected therewith.

LONDON COUNTY COUNCIL ELECTRIC POWER SUPPLY BILL (1907).

A MUNICIPAL ENTERPRISE CRITICISM.

THE following is extracted from a communication received from Mr. H. W. Littler, chairman of the Electric Light and Tramways Committee, West Ham:—

Briefly, the Bill seeks powers to acquire compulsorily the existing electricity supply concerns of companies and local authorities in the County of London, and to acquire what the promoters think necessary of those undertakings outside the County, and to compete directly with them for their existing and future business.

I think it inevitable that if general electricity supply powers are given to the L.C.C., the adjoining boroughs and municipalities, including West Ham, will be taken into London (in fact, it is already proposed by an influential section of the County Council). If they are not, there would exist the anomaly of a municipal trading concern competing with other municipalities engaged in the same business, and endeavouring to depreciate their property, in which they have put their money; but these undertakings, including West Ham, would have no voice or representation in the management of the competing concern. West Ham would appear to be in a worse position than would have been the case had the Administrative County of London Co.'s Electric Power Bill passed through Parliament, because in that case, competition at unprofitable rates might have been to a certain extent limited by the demands of their shareholders for dividends; whereas, in the case of the L.C.C., there would exist competition with no limit to unprofitable rates, which would result in the freezing out of the existing electricity suppliers, because apparently (*vide* tramways and steamboats), the County Council has no regard to balance-sheets or financial results. Immediately the existing suppliers were frozen out, and their undertakings taken over at scrap value, the charge could be increased to a maximum, no competitor being in the field.

It would be nothing less than disastrous to the manufacturers of West Ham if the district were taken into London. Because immediately this happens, the very stringent and, in my opinion, absurd by-laws as regards buildings, smoke nuisances, &c., would come into effect.

What is the sense of all this specious talk about improving London as a manufacturing centre, when the authority, instead of doing all that is possible to encourage manufacturers to remain where they are, appears to rack its brains to create conditions which drive them out?

Take, for instance, a chemical factory, of which there are scores in West Ham; how can they afford to erect substantial buildings to house plant for a particular process, which, by a freak or a discovery in the trade, may be of scrap value to-morrow?

It is not the rates which drive manufacturers out of London. It is the creation of conditions, which render impossible the profitable operation of factories liable to severe competition from the foreigner and the manufacturer who happens to be in an enlightened provincial town, where the authority regards him and his employés as most desirable acquisitions to the community.

By the construction of one huge electricity generating concern for London, the power users of West Ham are not going to get electric power any cheaper than they can get it from their own undertaking.

Why not? Because, in the first place, the scheme of the County Council provides for the purchase of about £14,000,000 worth of plant and buildings owned by the existing suppliers, which will, when bought, fall to the level of scrap value, thereby enormously inflating the capital expenditure.

The Administrative Co. were going to build their power station at a cost of about £10 per horse-power of plant installed, and then it was very problematical if they could, with the enormous cost of distribution, profitably sell at the *consumers' terminals* at a price below that at which, for example, the West Ham Corporation is selling to-day.

The capital per horse-power in the L.C.C. scheme will amount to nearer £100; and it is a moral certainty that with this initial burden remunerative low prices cannot be offered, apart altogether from the fact that the buildings and smoke stacks in the scheme of the Administrative County Co. were to be of steel construction, whereas the L.C.C. could hardly have the hardihood to contravene its own by-laws.

Can the ponderous organisation, administration and red tapeism of the L.C.C. lend themselves to the development of such a highly speculative business as electric power supply? Imagine a gold-laced official interviewing a bone and fat boiler, and informing him that as his requirements will entail an extension of 10 yds. of cable, the permission of the County Council, on Form 141B, must be obtained before any further steps can be taken; or, imagine him offering an unbelieving manufacturer to equip his factory with motors on trial for six months, with the option of throwing the whole lot out if unsatisfactory in practice; but this kind of thing must of necessity be done if power business is to be obtained.

Apart from all this it has not, by a very long way, been proved that an immense electricity supply concern, operating over a huge area, can sell at the consumers' terminals more cheaply than one of moderate size, serving a compact area. Admitted that it can generate rather more cheaply, this advantage is more than neutralised by the greatly-increased expense of distribution over the large area that must be tapped to keep the large generating station going.

I do not refer to the provincial power companies and large corporations supplying electricity to outlying hamlets and small towns; this is a totally different business, because these small places could not expect business of more than a few hundred thousand units per annum if they built their own power station, and the charge to their consumers would be prohibitive on account of the cost of operating on such a small scale. That question does not arise, as regards London power supply, because here we have proposals to supply in bulk to, and to take over, companies' and local authorities' concerns, many of whom individually have a business equal to that of the provincial power companies themselves.

The Administrative Co., whom the L.C.C. first opposed and has now imitated, relied largely on their experience with the Newcastle-on-Tyne Electric Power Supply Co., so let us look carefully into this.

The company is about the largest electricity supply concern in this country, but it only makes 5 per cent. gross profit upon its total capital, *and allows the insignificant amount of* 1 *per cent. for depreciation.* This, to commence with, is not very bright, especially if one considers that the West Ham undertaking cannot declare a net surplus until it has paid 7½ per cent. on its total capital in the form of interest and sinking fund payments.

Newcastle's total cost of operation is ·57d. per unit sold—a little over ½d. If size and huge range of operations are necessary to success, why can a small company (Prescot), with less than one-tenth the business of the Newcastle concern, make a unit for under ½d. Or why can Salford, one of the much-abused Corporations, with a business one-third that of Newcastle, make a unit at the same price as the latter? Or a little Corporation (Partick), one-eighteenth the size of Newcastle, make a unit for ·65d.?

On the other hand, it costs Manchester, with an output of 40 million units, more than ¾d. to make a unit. I say it has not been proved that a huge supply undertaking can sell a unit *at the consumers' terminals* cheaper than a smaller one with a compact area.

Are manufacturers crying out for cheap power? No, they are not. This question of cheap power is a popular fetish brought into being by the exceedingly vague, but attractive offers, of the Administrative Co.'s canvassers two years ago, offering to power users electricity at ½d. per unit, and so forth. These prices they would never get, but at the same time the promise brought a goodly number of well-wishers into the witness chair, and produced strings of petitions in favour of the Bill. From the promoters' own proposed tariff of charges, if properly worked out, it was obvious that power would not be obtained much cheaper, if at all, than from several London supply concerns, and certainly not as low as the maximum charge of 1d. per unit, which is now getting common in London, and has been charged in West Ham for some time past.

But the fetish remains in the imaginative brains of the staff of the halfpenny Press, and others who should know better, and they periodically emit a popular scream. As a matter of fact, cheap power is about the last thing manufacturers are thinking about.

If the manufacturers were crying out for cheap power they would, as business men, come to the existing supply concern and find out what it could offer them. Then, if too high, they could shout. But do we hear them shout?—No!

SOLUTION.

The London power problem is to be solved not by the creation of a huge generating station, but *by Parliamentary facilities for interchange and inter-connection between the existing stations,* thus setting free an enormous amount of spare and reserve plant, representing at present useless capital expenditure, and enabling the best situated stations to take care of the bulk of the load, and the less efficient ones to take the peaks. This would result in all-round economy and reduction of charges. Then when the present plant is worn out and written off, new power stations can be erected by combination of the existing suppliers of electricity outside the district.

If the business had not been started, it might possibly have been right to commence with a large electricity supply concern for London; but it is too late, and cannot be done now without enormous loss to the ratepayers and shareholders who own the present concerns, while it is practically impossible that any real advantage can come of it to consumers.

The capability of the London County Council to manage such an undertaking as that proposed, comes into question in the light of the cross-examination of its experts during the hearing of the proposals contained in the Bill of last year, for the electricity supply of London.

Among other absurdities proposed was the employment of steam colliers to take coal to the projected generating station at Battersea. By using such large craft they would reduce freight, and they relied on this advantage to reduce the cost of coal per unit generated. It was pointed out to them by counsel for the opposition that such craft would have the decks level with the parapets of the London bridges, while the keels would be stuck fast in the mud.

Another point was that they proposed to generate and send through their cables a current at a pressure of 6,000 volts; this, remember, for the supply of all London and the outskirts. It was pointed out to them that they would have to purchase a copper mine to do it. About 20,000 volts would be nearer the mark, as was kindly pointed out to them by opposing counsel.

An elaborate table was prepared and put in showing how largely West Ham would gain by taking power from the L.C.C. instead of continuing to generate for themselves. This was conclusively proved by our engineer to be a miscalculation, to put it mildly. Counsel stated that West Ham, by taking power from the L.C.C.,

would be the loser to the tune of many thousands of pounds a year. This correction was accepted without any protest by the promoters.

These are only three examples of many, but they are bad enough to show how carelessly the scheme had been brought out. That Bill, and the present one, too, as far as one can see, show no originality whatever—merely wholesale appropriation of the ideas of the Administrative Co. and other similar schemes for London power.

Does it not strike one that there would be an enormous risk in investing millions of the ratepayers' funds in such a highly speculative and uncertain business, in which there is no experience to go by, and can anyone have any confidence whatever in the capability of the L.C.C. to design and carry out such a business, in the light of what happened in the Committee Room last year?

We have no mind to see our undertaking swallowed up by the rapacious dragon of self-aggrandisement—the L.C.C.; and the case of other districts, both metropolitan boroughs and outside authorities, is similar to ours.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

G.E.C. Radiators.

In a new radiator booklet which has just been issued by the General Electric Co., Ltd., of Queen Victoria Street, E.C., a number of new ornamental designs figure. These are on the glow lamp

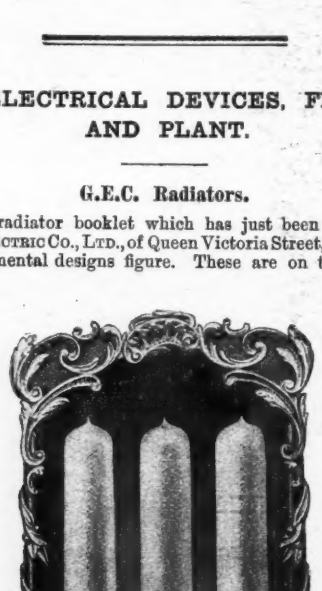

Fig. 1.—G.E. Co's "Louis" Radiator.

principle ("Archer" system), and are excellent art metal designs, each having an appropriate title, such as Czarina, Thistle, Shield, Shamrock, &c. In fig. 1 the No. H 326 "Louis" design for drawing

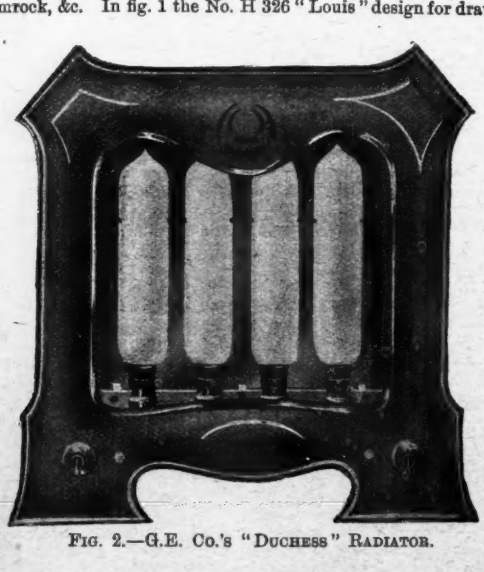

Fig. 2.—G.E. Co.'s "Duchess" Radiator.

and dining-rooms, bedroom use, &c., is illustrated. This is made in both 3 and 4-lamp sizes, and has two regulating switches; it is especially designed for use in places where an ornamental pattern is required. Another new and serviceable design is the "Duchess," with four lamps and two switches, as shown in fig. 2.

In the same pamphlet there are illustrations of "Pillar" type radiators for hall and shop service, also non-luminous patterns for small offices, warehouses, ships, and tram and railway cars. An improved pattern bed warmer with flexible cord and plug appears in fig. 3.

We understand that the company has revised the whole of the list prices, so that they are now inclusive of any trade advances made in the past, but as compared to the previous edition it is

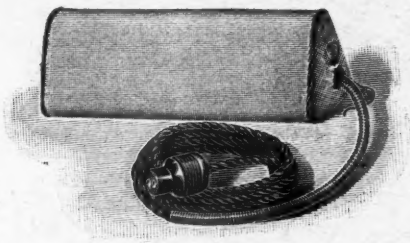

Fig. 3.—Electric Bed Warmer, by the G.E. Co.

stated that in practically every case considerable reductions in prices have been effected. Every reduction in the price of such apparatus is sure to help in the work of popularising electricity for heating purposes.

Modern Railway Station Lighting.

Now that many of the electrification schemes in connection with various railways in and around London have been brought to a successful issue, it may be interesting to briefly refer to the most recent practice in station lighting. We understand that all the latest tube railways, such as the Metropolitan District Railway, Baker Street and Waterloo, Great Northern, Piccadilly and Brompton, Charing Cross and Hampstead, together with the London and South Western Railway, and other railways, have adopted semi-enclosed arc lamps of the Maxim patent type (fig. 4). These lamps are run five in series upon circuits varying from 500 to 600 volts, and by judicious arrangement, an agreeable light without shadows is obtained throughout the whole of the area lighted, which, it is contended, would be quite impossible with fewer lamps of a larger candle-power placed at longer intervals.

Each lamp is entirely self-contained and interchangeable, and in the type used the Maxim Electrical Co., Ltd., place a substitutional resistance sufficient to absorb the extra voltage, should one or more of the lamps fail from any reason. This resistance is supported on specially designed porcelain blocks placed in the hood or

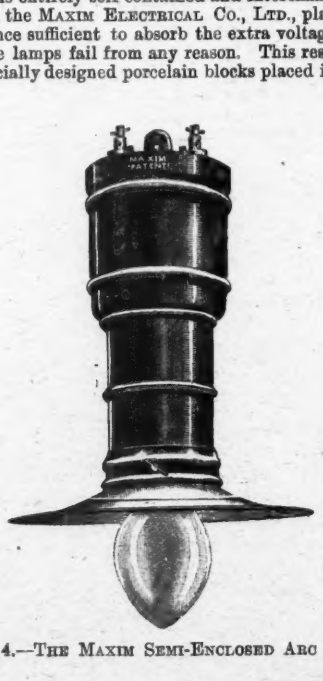

Fig. 4.—The Maxim Semi-Enclosed Arc Lamp.

upper part of the lamp, and it is stated to be almost impossible for the resistance coil to droop or sag in any way. There are two separate chambers in the lamp; the upper one, which is ventilated but weather-proof, contains the necessary line and substitutional resistances, while the lower is dust-proof, and contains the solenoids and lamp mechanism, including the automatic cut-out.

The current consumption is 5 amperes, while the carbon life is about 80 hours per trim. The method of trimming and fixing the globe is very simple and can be speedily carried out, an important point when dealing with a large number of lamps continuously burning.

Another very important feature in comparing open type arc lamps as against lamps of the type described, is that whereas in the case of the open type, both carbons are consumed and need refixing

approximately every eight hours, in the semi-enclosed type one carbon only is needed every 80 hours, thus saving a large amount both in labour expended and material used.

The lamp is of substantial manufacture throughout; the outer case, which is of steel covered with a hard vitreous enamel, is very durable as well as being neat and attractive in appearance.

LEGAL.

Davies *v.* Rockhouse Hotel Co., Ltd.

This case came before Mr. Justice Neville on Thursday last week, and was an action for an injunction to restrain the defendant company from causing or permitting any offensive smoke, fumes or vapour to proceed from the chimney of their electric generating station, and from causing a noise or otherwise working the said station in such a manner as to be a nuisance or injury to the plaintiff. Defendants carried on business as hotel proprietors at Llandrindod Wells, Radnorshire, and their generating station supplied the hotel with electric light, the station being on the south side of the hotel, and having a chimney about 18 ft. high. There was a row of seven dwelling houses in West End Avenue, and owing to a slope in the ground the top of the chimney was on a level with the ground floor windows of these houses. Plaintiff was the tenant of one of the houses, and carried on the business of a lodging-house keeper.

Plaintiff's case was that the smoke from the chimney was a great nuisance to him when the wind was blowing from the west and south-west, and that the noise from the generating station was very objectionable and disturbing, while in consequence of the nuisance he had lost several lodgers.

Defendants' case was that the nuisance of which the plaintiff complained, was greatly exaggerated.

At the conclusion of the evidence, Mr. Justice Neville held that although the evidence was of a very fluctuating nature, plaintiff had proved his case, and was entitled to an injunction as claimed. He accordingly granted the injunction, and gave judgment for the plaintiff, with costs.

Punter *v.* L.U. Tramways (1901), Ltd.

At the Brompton Court on 21st inst., plaintiff, a builder, of Hammersmith, claimed damages in respect of injuries said to have been caused by a live electric wire. According to plaintiff's counsel's statement, plaintiff was riding on the top of one of defendants' cars on August 4th, when an overhead wire broke and fell on to the car. Punter saw it coming, and "ducking" to avoid it, must have touched the brass rail against which the wire fell. The result was that he received a severe shock, and had been incapacitated ever since.

Plaintiff said that when the wire fell away from the car top, he was released and collapsed on to the flooring. Sleeplessness and inability to eat had followed the accident. He smoked ½ oz. of shag a day, but denied that his nervous condition was in any way due to excessive smoking.

For the defence it was submitted that the wire which fell on to the car top was not a "live" wire, and that plaintiff imagined he received a shock through fright.

Dr. Howett, for the defence, said that ½ oz. of shag daily was quite enough to set up tobacco poisoning and blindness, and that plaintiff's symptoms were identical with such a complaint.

Mr. W. Nearn, in charge of defendants' installation, sought to show the impossibility of a live wire falling at such a point. The wires were inspected once a month.

The jury awarded plaintiff £50 damages, and added that they considered the overhead wires should be inspected more frequently than at present.

Workmen's Claim Against L.C.C.

In the Shoreditch County Court, on Tuesday, before his Honour Judge Smyly, K.C., two claims were heard before a jury, in connection with the fall of a wall at a new electric station of the L.C.C. in Rivington Street, Shoreditch. At the time of the accident one man was killed, but this claim was not gone into on this occasion. The first claim was brought by Wm. Richard Alexander, a bricklayer, 27A, Penwith Road, Earlsfield, to recover from the L.C.C. £150 damages for injuries sustained; and the second claim was that of Ernest Arthur Gathersole, a bricklayer, of 132, Maysoule Road, Plough Road, Battersea, to recover £250 under similar conditions. It was decided that the jury should try the first case, to arrive at a decision on the question of negligence, which result should govern the second case.

Mr. Harold Morris, barrister, appeared on behalf of the plaintiff: and Mr. Baylis was counsel for the defendants.

The plaintiff's case was that he was working with the other plaintiff on a wall which had been 22 ft. high, 17 ft. long, and 9 in. thick. The height had been reduced to 10 ft., and in the course of the erection of the new electrical works of the L.C.C., it was decided to take 2½ in. off the face. The usual method of doing this was employed, that being for one man to start at each end and make a "mark" about 5 ft. from the level, until they met each other. The wall had been underpinned and struts put up, but the struts were, for some reason, taken away, and no stays were put in their place. Had this been done, the accident could not have occurred, as the weakening of the wall by making the groove would have had no effect. As it was, after the groove had been made, the wall became top heavy and suddenly collapsed. Plaintiff was so badly injured that he was laid up in hospital for over a month, and it was three months before he could really do anything. He had been made a compassionate allowance by the L.C.C. of £1 a week.

For the defence it was submitted that the wall must have been weak in parts, and this could not possibly have been known. The underpinning and strutting was carried out at a proper time, and the accident was inexplicable.

Eventually, the jury found for the plaintiff £50 damages and costs.

Acting upon this decision, the parties agreed upon a verdict for £125 damages and costs, being entered in the second case, which was accordingly done.

BUSINESS NOTES.

Trade Statistics of Denmark.—The recently-issued Annual Trade Statistics of Denmark give certain particulars as to the importation of electrical materials into that country in 1905. The imports of electrical cables and wire amounted in value to 380,000 kroner in 1905 (9,400 kroner from Sweden, 285,572 kroner from Germany and 57,381 kroner from Great Britain), as against 130,010 kroner in 1904 (Germany 84,357 kroner, Great Britain 615 kroner). The imports of accumulators in 1905 were valued at 209,359 kroner (Germany 168,537 kroner), as against 167,700 kroner in 1904 (Germany 159,143 kroner). Galvanic elements were valued at 5,753 kroner and 9,690 kroner in 1905 and 1904 respectively (Germany 3,297 and 7,819 kroner). Carbons were imported to the value of 51,559 kroner in 1905 (Germany 35,498 kroner, United Kingdom 119 kroner, France 2,808 kroner, United States 3,400 kroner), as against 42,550 kroner in 1904 (Germany 40,180 kroner, United Kingdom 192 kroner, France 767 kroner). Incandescent lamps were valued at 51,300 kroner (Germany 49,318 kroner), as against 41,480 kroner (Germany 40,563 kroner). Telegraph, telephone and electrical apparatus not separately shown was imported to the value of 665,500 kroner in 1905 (Sweden 5,006 kroner, Germany 583,039 kroner, United Kingdom 2,220 kroner, France 12,806 kroner and United States 45,433 kroner), as against 682,940 kroner in 1904 (Sweden 15,718 kroner, Germany 538,281 kroner, United Kingdom, 4,853 kroner, France 9,450 kroner and United States 1,000 kroner). We are of opinion that British electrical firms would find it well worth their while to pay greater attention to the possibilities of Denmark as a market for their goods. At the present moment the Copenhagen public authorities are inviting tenders in this country for turbine plants, &c., and we are able to state that before long a great deal of electrical machinery will be required.

Consular Notes.—Tunis.—The British Consul at Tunis in a recent report, writes as follows:—The best opinion I can obtain as to how our trade in hardware and machinery could be improved is to the effect that British firms should make themselves more directly acquainted with the varied nature of local requirements, and simultaneously place before purchasers more complete details and general information concerning the excellence, cheapness and diversity of British manufactures. In a previous report (1902) I stated that an "illustrated catalogue in a language wholly foreign to the large bulk of the people here is scarcely sufficient, more particularly on subjects which bristle with technical terms, and where weights and measures are largely referred to. To ensure a market, some degree of personal enterprise is needful. The Consulate does its best to distribute the circulars, price-lists, catalogues, &c., which reach it and to reply to all inquiries that are sent from time to time; but this can scarcely give much impetus to business." What I wrote then appears to me to hold good to-day. What is wanted is personal inspection from home, if possible, by agents having a fair acquaintance with the French language. An occasional visit would enable a commercial agent to take home, apart from actual orders, a clear knowledge of local requirements, and of how his firm could best set to work to advantageously compete for their supply; and he could easily obtain at first hand, or with the assistance of the Consulate, reliable information as to the various quarters in which business could safely be done. And it might well repay expenses to establish a depôt or two of samples of British manufacture. In any case, I imagine that such efforts could not be very costly, and would be more useful in the end, and in regard to a country whose commercial, industrial and economic development generally is in constant progress, than the relative apathy arising out of suspicious prudence, varied by an occasional bad deal with some plausible correspondent.

In 1905 hydraulic machinery came from France to the value of £3,200, from Italy £1,200, and the United Kingdom £300; dynamos were imported from the United Kingdom to the value of £2,000, France £2,200, out of a total of £4,500. In machine tools we were nowhere—£200 against France £6,400, other countries £1,000. In general machinery, however, such as driving gear, railway-fixed plant, cranes, &c., we took a fair share of the trade—£12,000, as against France £27,000, Switzerland £8,000, the United States £5,000, out of a total of £60,000. Nowhere else do we come into line.

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China.—The Austro-Hungarian Consul at Shanghai, in a recent report, states that the imports of electro-technical materials in 1905, amounted in value to 1,820,000 fr., as compared with 1,250,000 fr. in 1904. The chief supplying countries in 1905, were:—Great Britain 876,556 fr., Germany 382,948 fr., Belgium 73,412 fr., and United States 117,705 fr. Electrical machines are difficult to sell singly; the chief suppliers are United States and Germany, and the chief purchasers, the small Chinese machinery works which are to be found in considerable numbers on the Lower Yangtze.

Bankruptcy Proceedings.—Geo. Swann & Sons.—The public examination was held on 15th inst. before Mr. Registrar Linklater at the London Bankruptcy Court of Harold Charles and Arthur Edward Swann, trading as George Swann & Sons, electrical engineers, &c., at 24A, Edward's Square, Kensington. The accounts filed under the proceedings showed liabilities £398 and assets £87. In the course of the evidence, the debtors stated that the business was established by their father, who took them into partnership in October, 1901, and gave them each a one-fourth share. On the death of the father, in March, 1904, they took over and subsequently continued the business on equal terms until the failure, which was caused by an adverse decision in an action they instituted to recover £90, the balance of an account for work done to a property at Weltje Road, Hammersmith. The action was defended, and in April, 1906, an award was given in favour of the defendant, with costs. The latter were taxed at over £100, which they were unable to pay, and on October 31st, 1906, the judgment creditor made them bankrupt. The examination was concluded.

Ernest Crompton Holt, electrical engineer, of Rhyl, Congleton, Carnarvon, Llandudno and Colwyn Bay, appeared on Thursday last week at the Bangor Bankruptcy Court. The Assistant Official Receiver expressed the view that he had opened too many businesses.

Catalogues, Calendars, Lists, &c.—Messrs. Bruce Peebles & Co., Ltd., London and Edinburgh.—Advance copy of pamphlet No. 18, in which they give full particulars of a new line of continuous-current generators which they are now pushing. Full details are given of the construction, the most interesting feature being the use of commutation poles throughout; size numbers, ratings at various speeds, weights and prices are conveniently arranged for ready reference. The illustrations admirably show the 1,000-kw. machines at the Cathedral Street sub-station of the Glasgow Corporation, also parts of machines.

Messrs. John Dugdill & Co., Failsworth, near Manchester.—Large postal card illustrating their various patent movable fittings.

National Telephone Co., Ltd., Telephone House, Victoria Embankment, E.C.—In our issue of December 21st, 1906, we referred to a number of sections of a new sale catalogue which were then in circulation. We have now received two further sections. No. 2 is a very full list (118 pages) of a great variety of telephones and telephone accessories, including transmitters and receivers, headgear, magneto wall and table sets, common battery sets, battery intercommunication sets, mining and engine house instruments, traction telephones, sub-station sets, telephones for use on existing bell wires, and so on. In Section VII are particulars of electric motors, clocks, tell-tale clocks, hot-air engines, &c. Both lists are excellently arranged, finely illustrated, and contain notes of prices.

Horsfall Destructor Co., Ltd., Leeds.—Illustrated catalogue (190 pages), with red board covers with gilt lettering, in which are given full particulars with line drawings and photographic pictures of a large number of destructor plants erected by them on their well-known system. Plants at West Hartlepool, Fulham, Leeds, Pembroke, Southport, Finsbury, Paisley, Hamburg, Brussels, Huddersfield, Bradford, Accrington, and so on, are described; but, in addition to the descriptive matter, there is also information concerning tests carried out on various installations. A number of pages are devoted to particulars of clinker crushers, mortar mills and many other types of auxiliary plant used by corporations and councils.

From The Electric and Ordnance Accessories Co., Ltd., Stellite Works, Birmingham, we have received a hanging wall calendar with monthly slips. The upper half of the calendar consists of a very pleasing design in colours embodying views of their manufactures, such as motor controllers, starting panels, pressure and universal fans.

Messrs. Hodgson Wright & Wood, Century Works, Pellon Lane, Halifax.—List No. 22 giving illustration and particulars of prices, weights, &c., of their shunt-wound dynamos of the multipolar protected type from ·4 to 25 kw.

Messrs. Baxendale & Co., Miller Street Works and Warehouses, Manchester.—Set of 64 illustrated and priced sheets, giving information relating to their many electric bells, and accessories therefor, such as indicators, pushes, wires, and batteries. Some good examples of decorative bell pushes in china and art metal, door contacts, burglar alarms, mining and out-door bells, are included, also induction coils, electro-medical sets, lightning conductors, and so on. The whole are brought together in an extremely convenient spring binder, which makes the substitution of new lists for old a very easy matter.

Messrs. Mavor & Coulson, of Glasgow, have in circulation a wall calendar with monthly slips bearing bold figuring. A half-tone illustration of an undertype three-phase Pick-quick coal-cutter on skids appears above the date slips.

Weston Electrical Instrument Co., Audrey House, Ely Place, London, E.C.—New list, No. D1, containing a full description of the multimeter, which is their latest model portable testing set. An excellent illustration is given of the multimeter with leads attached to 1·5 ampere shunt, also one of the cover of the instrument showing a diagram of connections.

Mr. Wm. Boby, Salisbury House, London, E.C.—New catalogue (No. 38) which is on the point of issuing, giving a very full and well-illustrated account of his "Simplex" water softening apparatus, his patent filters for clarification of turbid waters, also his patent Ferrochlore process for the sterilisation and purification of potable water. A good deal of general information on the subjects to which these relate accompanies the descriptions. Lists of users are also given.

Messrs. Wm. Wadsworth & Sons, School Hill, Bolton.—Very fully illustrated catalogue (76 pages) containing brief descriptive accounts of their various manufactures in hoisting machinery. The firm devote themselves exclusively to lift and hoist manufacture, making all kinds of lifts (excepting hydraulic), belt-driven and electric lifts for warehouse or factory use; electric passenger and service lifts for hotels and public buildings; also self-landing and delivering hoists. All of these and many other lines are included in this catalogue.

Hooper's Telegraph and India-Rubber Works, Ltd., 31, Lombard Street, E.C.—Newly issued price list of electric light wires and cables, jointing materials, &c. It may be noted that a 2,500-megohm grade of electric wires and cables has been added, making four grades in all, namely, Hooper's standard quality, 2,500-megohm, 600-megohm, and 300-megohm grades. Two diagrams are given, on a scale of 10 : 1, which indicate at a glance the relative thicknesses of the layers of insulation, braiding, &c., for any given size of conductor.

Union Electric Co. Ltd., Park Street, Southwark, S.E.—New illustrated list, No. 1,371, describing and stating prices of their searchlights or projectors for direct current, types KL and MJ, which are already familiar to the trade, but in which several improvements in detail are now added. We understand that the MJ type of apparatus has shown itself very useful, owing to the carbons feeding, and the arc striking, entirely automatically. There are four of these projectors in use at the Crystal Palace, throwing their light down on the centre circus arena; only one man is required for their control, although they are situated at four corners of the building. The KL pattern, a smaller one, is being largely used for ships and stages where powerful illumination is required.

Messrs. Aston & Mander, Ltd., 61, Old Compton Street, Soho, W.—New circular relating to their improved drawing instruments.

Messrs. Nalder Bros. & Thompson, Ltd., of Queen Street, E.C., have sent us one of their usual type calendars for the current year.

Mr. Chas. Pullan, Bradford.—Illustrated circular, showing the oil and waste-saving machines for which he is agent.

We have also received a similar circular from Mr. Jean Schmidt, of 20, High Holborn, W.C., who claims to be the sole representative for these specialities in the United Kingdom.

Western Electric Co., North Woolwich.—Slips of revised prices for insertion on various pages in the catalogue of telephone instruments and accessories which the firm issued in December, 1902. These prices cancel all previous quotations. A separate circular gives particulars and prices of Blue Bell dry cells. It is intended shortly to publish the first of a new series of illustrated catalogues.

Messrs. Applebys, Ltd., of 56, Victoria Street, Westminster, of electric crane fame, have issued a hanging block calendar with daily slips, upon each of which there appears an illustration of an electric overhead transporter, travelling crane, capstan, cantilever crane, Goliath crane, electro-magnetic revolving tower crane, Giant crane, Gantry crane, or some other like speciality of their manufacture.

Messrs. L. E. Wilson & Co., 20, Cross Street, Manchester.—Circular describing the Wilson-Birtill twin ignition regulator for low-tension magneto.

Controller Fingers.—Messrs. Imeson Bros., Finch and Co., of Stockton-on-Tees, have fitted their patent controller fingers in all the controllers employed on the Grimsby tramway system.

A Copenhagen Exhibition.—An International trade journals exhibition is to be held in Copenhagen in June in the current year. A special feature will be art in relation to advertisements. Offices of the exhibition: 14, Colbiorns-sensgade.

Exhibition at Amsterdam.—An International exhibition of motors and prime movers suitable for small industries will be held at Amsterdam from August 15th to September 15th in the present year. The exhibition is being promoted by the Société pour l'Encouragement de l'Industrie.

Effects of a Gas Explosion.—We have received some interesting photographs of the interior of a private house at Hornsey Rise, N., showing the damage done in a number of rooms by a gas explosion which recently occurred owing to leakage of gas from a water-slide fitting in the morning room. Although the ceilings in many of the other rooms were blown down, and most of the furniture was practically ruined, all the electric light fittings remained hanging in position securely fixed. These fittings were put up by Messrs. F. Chase & Co., of Greyhound Road, Tottenham.

Annual Dinners.—The third annual staff dinner of the Anchor Cable Co., Ltd., was held on Saturday, January 12th, at the Co-operative Hall, Leigh. Mr. H. R. Garrard, works manager, occupied the chair, and 25 persons sat down to dinner. During the evening letters apologising for inability to be present were read from Mr. J. O. Callender and Mr. T. Petersen. After dinner, songs were rendered by the members of the staff, and among the toasts honoured were the following: "Mr. T. O. Callender and the Parent Company," "The Anchor Cable Co.," "Mr. J. O. Callender and Mr. T. Petersen," "The Press," and "The Chairman."

Trade Announcements.—THE CRYSTALATE MANUFACTURING CO., LTD., are now conducting their business from Tonbridge, instead of from their London office.

THE ANTI-ATTRITION METAL CO., LTD., have removed their registered offices to 50, Cannon Street, E.C. All communications should be sent there and not to the works.

THE D.P. BATTERY CO., LTD., have transferred their registered office to Lumford Mill, Bakewell, Derbyshire, where all matters of inquiry, accounts, &c., will be attended to. Except for the above transfer, no other alteration will be made in connection with the London office, 11, Victoria Street, Westminster, S.W.

Mr. W. H. R. CLEAVE, of 6, Bristol Bridge, Bristol, has resigned the agency there of the Electric and Ordnance Accessories Co., Ltd., and from the 1st prox. he will carry a stock of the electrical supplies of Mr. G. Braulik, of Upper Thames Street, London, whom he now represents.

MESSRS. W. E. BURNAND & Co., of Lowfield Works, London Road, Sheffield, have purchased the patterns and most of the manufacturing plant of the Burnand Transformer Co., Ltd., of Oxford Street, Salford, and they announce that these transformers, in which they have effected a number of important improvements, can now be obtained from themselves alone. They are being made under the direct supervision and control of the originator and inventor. New works are rapidly approaching completion. More than three-fourths of the work done last year was on repeat orders. An illustrated leaflet just received shows a 500-KW. single-phase transformer and other specialities.

MESSRS. DAVIDSON & CO., LTD., of Belfast, announce that owing to the increasing requirements of their business in Scotland, they are taking larger and more commodious offices in Glasgow. After February 1st the address of their branch office in that city will be 53, Bothwell Street.

Mr. J. HENRY PHELPS, of Splott Road, Cardiff, has been appointed agent for Messrs. J. E. Spagnoletti & Co., for the South Wales district.

Canada.—THE CANADIAN GENERAL ELECTRIC CO. have decided to increase their factory accommodation by the addition of a two-storey building, 250 ft. long. The new portion will be devoted to the lamp and wire departments. It is expected that work on the new additions will be commenced in April next.

Para Rubber.—The *Financial News* says that rubber to the value of £3,500,000 was produced in the State of Para during the year ended June 30th, 1906.

Concert.—The staff of the Adams Manufacturing Co., Ltd., gave a Bohemian Concert at the Central Restaurant, Bedford, on Friday evening last. About 25 members of the London staff joined their co-workers at Bedford for the occasion, and the affair was so successful that plans are afoot among the staff for the establishment of a permanent social and entertainment organisation. Mr. Adams presided.

Book Notices.—"The Official Circular of the Tramways and Light Railways Association" for January contains a copy of the memorandum and articles of association in their amended form; a list of Bills relating to tramways only, and of Bills containing clauses relating to tramways deposited in Parliament in connection with the coming session, and a short description of each; a list of provisional orders deposited on or before December 17th, 1906; references to Light Railway Orders; and two letters from the Board of Trade on "Brakes" and "Lifting Jacks."

Messrs. Harper & Brothers are about to add another volume to their series of electrical handbooks:—"Elements of Electric Traction for Motormen and Others," by L. W. Gant, which, we are informed, is specially written for motormen, depôt foremen, inspectors, apprentices and others employed on electric tramway systems, to serve also as an elementary text-book for students beginning the study of electric traction. The work is illustrated by specially prepared diagrams.

"The Journal of the Franklin Institute." Vol. CLXIII, No. 1, January, 1907. Philadelphia, Pa. The Institute. Price 50 c.

"Fowler's Mechanical Engineers' Pocket Book for 1907." Edited by Wm. H. Fowler. Manchester: The Scientific Publishing Co. 1s. 6d. net.

"Gas and Oil Engines." By Horace Allen. Manchester: The Scientific Publishing Co. 1907. Price 12s. 6d. net.

"Die Kohlenglühfaden fur Elektrische Glühlampen." By H. Weber. Hanover: Dr. Max Janecke. 1907. Price 5.60 marks.

"Transformatoren und Asynchronmotoren." By W. Winkelmann. Hanover: Dr. Max Janecke. 1907. Price 4.20 marks.

Ediswan Lamps.—In our issue of February 3rd, 1905, we mentioned that as the result of independent tests made at the Westminster Electrical Testing Laboratory, the "Royal Ediswan" lamps came out at the top of the list. Another series of tests has lately been carried out by the same authority, with 16-C.P. 200-volt lamps of nearly a dozen different makes, purchased without the knowledge of the makers. The "Royal Ediswan" lamps again showed the best efficiency; starting at less than 3·3 watts per candle, they finished at slightly less than 4·0 watts per candle at the end of 500 hours, the average consumption being but little more than 3½ watts per candle for the whole period. The candle-power of any of the lamps at the end of the test was within ½-C.P. of the mean, that is, within 8 per cent. of the rated candle-power. This was the best result as regards candle-power and economy in energy consumption. The average C.P. throughout was well sustained, and the whole of the lamps easily complied with the new Standard Specification, except in initial C.P., which was rather high. The total watts at start and finish were less than 60.

Dissolutions and Liquidations.—LLANRWST ELECTRICITY SUPPLY CO., LTD.—A petition, presented by T. B. Farrington, civil engineer, Trinity Chambers, Llandudno, a creditor, for winding up this company, will be heard at the Court House, at Blaenau Festiniog, on February 7th.

JOHORE RUBBER AND PROSPECTING SYNDICATE, LTD.—A meeting is to be held at the offices of Messrs. G. D. Peters & Co, Moorgate Works, Moorfields on February 19th, to hear an account of the winding up from Mr. P. Gow, the liquidator.

Charge of Stealing Fittings.—At Westminster Court on 19th inst., Thomas Young, 29, was remanded in custody on a charge of stealing electric light fittings from his employer, Mr. William Seymour, electrician, Ellis Street, Sloane Square, S.W.

LIGHTING and POWER NOTES.

Aberdare.—The B. of T. has deferred for a year the question of revoking the E.L. order of the U.D.C.

Bath.—Negotiations between a special Sub-Committee and certain gentlemen, in regard to the offer to purchase the Council's electricity undertaking, mentioned some time ago, seem to be still going on, but so far nothing definite has transpired.

Bristol.—The letter published from a correspondent signing himself "Protectionist" in last week's ELECTRICAL REVIEW, excited interest in Bristol, where there was no idea among the citizens that plant for the extended Corporation generating station at Avonbank was being made out of this country. Alderman Pearson, the chairman of the Bristol Committee, in response to questions, stated that the Committee when it awarded the contract, knew nothing of the work being done outside the country, but he was not surprised at the statement that this was being done abroad. The Committee gave the contract to an English concern—the British Westinghouse Co., not because there was any predilection in favour of that company, but simply because their tender was £2,000 lower than that of their nearest competitor. The steam turbo-alternator was of 3,000 KW. capacity, and by the contract the British Westinghouse Co. undertook delivery by October last, so that the machine might take its share of the winter load. The fact that the machine was not delivered at the time contracted for, gave rise to questions which have to be dealt with. That was, however, a separate question to be now raised. Alderman Pearson did not think the terms of the contract prevented a manufacturer purchasing from abroad or manufacturing out of this country parts of an appliance, and he had little doubt that if a Corporation representative went to the British Westinghouse Works at Manchester, he would be able to see the work of building the turbo-alternator in progress, although possibly parts of it had been made in America. The Bristol Committee preferred English-made equipment, but foreign competition was very keen, and occasionally difficult questions arose with regard to allocating contracts. According to another authority, it is not the whole turbo-alternator that is being made in America for the British Westinghouse Co., but only part.

Canada.—ONTARIO.—The results are now to hand of the voting in the various municipalities of Ontario on the power question. In every place the power by-law has been carried by large majorities. Since the electorates' decision, the Hydro-Electric Power Commission has held a meeting at which it was decided to continue negotiations with the companies developing power at Niagara Falls, with a view to giving them another, and, it is stated, a final opportunity of submitting revised prices for the supply of power to municipalities in the Niagara district which have applied for it. Upon these prices will, in a large measure, rest the future policy of the Government Commission as to the means to be adopted to supply electric power at a cheap rate. It thus remains to be seen whether the work of bringing the power to the various municipalities is done by transmission lines built by the Government, or by private individuals in response to calls for tenders, or by contract with existing companies.

OTTAWA.—The new Electricity and Fluid Exportation Act which is to be brought forward as a Government measure at the forthcoming Session of the Dominion Parliament, not only applies to electricity, but also prohibits the exportation of fluids such as petroleum and natural gas. Used in reference to electrical power the terms "export" and "exportation" relate to the export or exportation by means of lines of wire or other conductors. The Bill provides that no person shall export any power or fluid without a licence, or no power or fluid in excess of the quantity permitted by such licence; provided that any person who immediately prior to the passing of the Act is lawfully engaged in the exportation of power or fluid, shall not, with respect to such exportation, be subject to the provisions of the Act, until three months after the Act goes into force, or until he has sooner obtained a licence under the Act; provided also that his exportation does not at any time during the interval rateably exceed in quantity of power or light, the amount which he was exporting prior to the passing of the Act. No person shall, without a licence, construct or place in position any line of wire or other conductor, for the exportation of power, or any pipe line or other like contrivance for the exportation of fluid. The Government may grant licences for the exportation of power or fluid. Such a licence must limit the quantity to be exported, and this must be limited to surplus after Canadian consumers have been

supplied. Every such licence shall be revocable. The maximum penalty for breach of the Act is fixed at $5,000 and the minimum at $1,000. For laying a main or establishing a wire for such unlawful exportation the penalty is the same, and the lines may be confiscated. The Governor-in-Council may, by proclamation, published in the *Canada Gazette*, impose duties not exceeding $10 per H.P. upon power exported from Canada.

Continental Notes.—SWITZERLAND.—Switzerland at present utilises hydro-electric power equal to 225,000 H.P., classified as follows:—13 per cent. for electric traction (tramways and railways); 23 per cent. for the electro-chemical industry; 40 per cent. for lighting, and 24 per cent. for motive purposes; notwithstanding which, it disbursed, between 1898 and 1904, 415 million francs on the purchase of foreign coal, which explains the eagerness with which new falls are being exploited. In the Canton of Berne there remains only the falls on the Oberland, estimated to give 37,500 H.P., for which concessions are being applied for. Nevertheless, this power is far from representing that actually required for heating, lighting and power purposes throughout the whole of Switzerland, for the railways need an average of 150,000 H.P. Hence a new concession has been asked for to utilise the Rhine above Mumpf, with a fall of 75 metres, which will require a canal and a 20-km. tunnel, 3,800 m. of whose length will be situated in the Soleure district, 8,900 m. in the Bâle-Campagne district, and 7,900 m. in that of Argovie.—*Industrie Electrique.*

FRANCE.—The Société d'Electricité de Paris, whose power station was recently described in this journal, has issued its report for the year ended June 30th, 1906. After referring to the installation of four turbo-alternators of 5,000 KW., the report states that the requirements of the Metropolitan Railway would absorb the whole of the output of these four sets, and that in view of the probable demand from other quarters it was decided in 1905 to increase the capacity of the Saint Denis station to 60,000 KW. by the erection of three turbo-alternators of the three-phase type, and three turbo-alternators of the two-phase type. A considerable amount of progress has been made since the date of the report, down to the end of 1906. It is expected to start two of the two-phase sets in March and to have the remainder in operation by August, when the capacity of the station will be brought up to 60,000 KW., as already mentioned. The report proceeds to state that the basis of the company's organisation is the agreement arranged with the Metropolitan Railway Co. for the supply of power during the period of the latter's concession, which runs to 1945. In addition to this, the company has agreements with the North Parisien Tramways, the Société d'Eclairage et de Force, the Edison Secteur, and all the other companies which require additional supplies to meet the larger demand anticipated from the impending reduction in the price of electricity in Paris. It would also be permissible for the company to approach manufacturers both in Paris and environs if it was considered advisable to do so, as the law of June 12th, 1906, has established free competition except in regard to lighting, although a decision on the subject is reserved by the directors. The accounts of 1905-6 show a credit balance of £17,500, which sum has been carried forward. The share capital amounts to £1,000,000, and the directors express confidence as to the future development of the undertaking.

TURKEY.—The Turkish papers on the 20th inst. announced that an Iradé was issued in October last authorising the Ordnance Dept. to make arrangements for the electric lighting of the city and suburbs, and the European shores of the Bosphorus. It is hoped that the Government will invite tenders from all countries for this important concession, which should afford British firms an opportunity of competing.—*Financial Times.*

NORWAY.—The Norse Electro-chemical Industry Association has, says *Affärsverlden*, made proposals to the Norwegian Government of a nature to arrest international attention. The negotiations have so far proceeded that a provisional agreement has been come to, of which the following are the main heads:—The company undertakes at the end of a period of 80 years to hand over to the Norwegian Government the Rjukanfos Waterfall in Telemarken, the Vamma Falls in Smaalene, as well as the Boilefos and Flatenfos Falls in Wedenæs—representing in all 310,000 H.P. In this transfer is included the waterfall plant and the electric power station and equipment, railways, &c., at each Fall. In the measure that the installations are completed they will be leased to the State so far as 5 per cent. of the power of each installation is concerned. On the other hand, the owners stipulate that the State shall consent to concessions on all necessary railways and power transmission lines; full freedom of trading for 25 years; and that the State do not hinder the participation of foreign capital in the company or companies, the management of which shall at all times comprise a certain proportion of Norse subjects. The Norwegian Government shall guarantee the company's bonds to the extent of 18 million kroner, which bonds shall be liquidated within 55 years, the State further binds itself not to impose before the expiration of the mortgages any special imposts for water-power or electrical working. The price for the State's final taking over of the stations is to be reckoned according to the number of electrical H.P. in the ratio of 100 kr. per H.P. The companies actually concerned in this scheme are the Norske Aktie Bolaget fur Elektrokemisk Industri, the Aktie Bolaget Rjukan and the Aktie Bolaget Vamma. The matter has peculiar interest in view of the recently issued Government regulations repressive of foreign control of Norwegian industries.

Coventry.—At a meeting of the Coventry City Council on Tuesday, Alderman C. West, chairman of the Electric Light Committee, stated that the manager had presented a very comprehensive scheme of extensions at the electricity works, which has been considered by the Committee and accepted by it. The scheme and the appointment of an outside expert is in the hands of an Executive Sub-Committee.

Bolton.—Messrs. Platt & Bleasdale, of Bolton, are putting down electric plant at the Drake Spinning Co.'s new mill on Larkhill, Farnworth. This mill will contain 110,000 spindles.

Dudley.—An industrial and trades exhibition, promoted by local enterprise, is being held in Dudley, with the idea of bringing before the public the numerous trades which are carried on in this busy part of the Black Country. At this Exhibition the Corporation Electricity Department has taken a stall, at which it is exhibiting D.C. Crompton motors; arc lamps and radiators, supplied by Messrs. Veritys; heating apparatus and electric signs, supplied by the Sun Electrical Co.; flame arc lamps and Kohinoor arc lamps, supplied by the Union Electric Co. With this exhibit and the numerous other attractions it is hoped by the department to bring prominently before the public, electric heating, lighting and power. The price of energy for lighting in Dudley is exceptionally cheap on the two-rate system, averaging about 2½d. per unit, and for power, 1d. per unit.

Dundee.—Mr. J. F. C. Snell has been selected by the Electricity Sub-Committee to report on the question of a new power station for the city.

Ealing.—A L.G.B. inquiry was held last week into an application made by the T.C. for sanction to a loan of £7,000 for the provision of additional plant at the electricity works. In regard to further extensions, Alderman Griffin mentioned the question of obtaining a supply in bulk from a company instead of expending further money on the undertaking. Alderman Peel, in reply, stated that after Mr. H. R. Hooper, last year, suggested that a spare set should be put in, he approached two companies about supplying Ealing in bulk. The company which could do so was the Metropolitan Electric Supply Co. from their works at Willesden. The company had quoted terms considerably in excess of the cost to Ealing, and they had not been able to come to terms. The engineers of the two undertakings had conferred with a view to modifying the terms quoted. We believe negotiations are still being carried on.

Egham.—On condition that the maximum charge of 8d. per unit is only levied in extraordinary cases, where the premises to be supplied are a great distance from the mains, the U.D.C. has agreed to withdraw its opposition to the prov. order for E.L., being applied for by the Egham Electric Supply Syndicate.

Grimsby.—The E.L. Committee on the 21st inst. reported that owing to the great increase in the demand for energy, it is necessary to further extend the plant at a cost of £4,000. A special committee was appointed to consider the question of applying for the necessary loan.

Hamilton.—The T.C. has agreed to ask the Secretary for Scotland for additional borrowing powers to the extent of £12,000 in connection with the burgh E.L. scheme.

Huddersfield.—The Corporation electricity works is to be extended, and new turbine plant installed.

London.—MARYLEBONE.—At the meeting of the B.C. on January 17th, the Electric Supply Committee reported that it very much regretted the interruptions which recently occurred in the supply of electricity in the borough. It had informed consumers who complained, that the failure was due to unavoidable accidents. Mr. A. Wright, the consulting engineer, had informed the Committee that the primary cause of these interruptions was flashing over at the commutator of one of the dynamos. At a conference of engineers, which was being held at the actual time of the second failure, it was stated by the manager of Messrs. Parsons & Co., the contractors who supplied the electrical plant, that the remedy which has been discovered for the electrical instability of the dynamos was to increase the width of the mica insulation between the copper commutator strips. This has been proved by the fact that since this modification in the manufacture of the machines, no flashing over of the commutators has occurred in the case of the dynamos which have been altered at the generating station or at other stations where similar alterations have been made. Four of the dynamos at the Council's generating station have now been altered, and the work of altering the remaining four is being proceeded with as fast as the armatures can be spared. The consulting engineer has for some time been in communication with the makers of the automatic cut-outs with a view to ascertaining what steps can be taken to ensure a faulty machine cutting itself out some seconds previous to the uninjured machines being cut-out by their circuit breakers by reason of excess of load, and Messrs. Siemens Bros., the manufacturers of the cut-outs, after experimenting for some time, have devised an arrangement, which appears to be satisfactory, by which this result may be obtained. In most D.C. stations supplied by slowly revolving armatures, the practice has been to abolish the use of maximum cut-outs so as to keep the uninjured machines on the circuit even at the risk of burning out their armatures. He does not recommend this practice being followed at Marylebone Station, owing to the danger of the

resulting increased load causing the other machines to flash over, as although the extra thickness of the mica will reduce the flashing over tendency under normal conditions, such flashing over might still occur on a sudden abnormal increase of load. It is, therefore, hoped that the device which Messrs. Siemens are prepared to install will prevent the necessity of keeping the machines in commission. Pending the alteration of all the armatures, and the installation of the new time limit cut-outs he (Mr. Wright) had given instructions for a man to be stationed at each turbine at all times of peak load, and to use the thin mica commutator machines as rarely as possible—in other words, to concentrate the load on the newly commutated machines. Messrs. Siemens Bros. have quoted for the supply, delivery, and fixing of the time limit arrangements for the switchboard for the sum of £12 each. The consulting engineer advises that 10 of these will be necessary, and the Committee has agreed to their purchase.

The installation of the system of the lighting of Oxford Street with arc lamps being complete, notice has been given to the Gas Light and Coke Co. to discontinue the supply of gas. The borough surveyor is to remove the lamps and columns.

STOKE NEWINGTON.—The E.L. Committee has passed an estimate of £300 for meters and £300 for house services. Failing the obtaining of more advantageous terms elsewhere, the Finance Committee has been authorised to borrow £5,000 from the L.C.C. for E.L. mains at 4 per cent. interest.

L.C.C. POWER BILL.—We understand that a meeting was held by the Middlesex C.C. at the Westminster Guildhall on the 15th inst., at which local authorities outside the L.C.C. area were invited to send delegates to consider a line of action in regard to the Bill. A conference was also convened by the Middlesex District Councils' Association for the 21st inst., at the same place, in regard to the above Bill.

A committee of combined London Ratepayers' Associations (some 44 in number) is organising opposition to the L.C.C. Electric Power Bill, and petitions are being prepared.

The experience gained by the Highways Committee of the L.C.C. has led to the conclusion that some further revision should now be made of the fees hitherto charged for meter testing, and that some modification of the rules should also be made. Negotiations on the subject have been entered upon with the B. of T., and the Board has intimated that it will be prepared to consider the question of giving approval to the proposed new rules and scale of fees after the publication of the proposals by advertisement. The Committee has accordingly had the revision made, and the scheme has been placed before the Council for approval.

SOUTHWARK.—The Works Committee and the Electric Lighting Committee report having considered the letter referred to them from the London Electric Supply Corporation renewing their offer to supply the Council with electricity for lighting public lamps at 1½d. per unit, and state that the Corporation has reason to believe that the offer, if accepted, would result in a substantial reduction in the cost of the public lighting of the borough. Both committees have decided in favour of no action being taken in the matter.

WOOLWICH.—In regard to the financial affairs of the B.C. electricity undertaking, we understand that the accounts of the undertaking are in such a state that neither the late nor the present Council could apply for a loan. There is an overdraft of something like £60,000, and of this amount £42,000 represents capital expenditure on electricity account; it is not known on what the money has been spent, and it cannot be allocated to its proper account. The chairman of the Finance Committee recently stated that the only way he could see of wiping out the overdraft was by levying an increase of from 6d. to 8d. in the £ on the rates.

Mitchelstown (Co. Cork).—The L.G.B. has sanctioned the application for a loan of £2,320, made by Mitchelstown R.D.C. for the scheme of electric lighting for that town. The loan is to be repaid in 25 years.

New Zealand.—WATER POWER SCHEME.—Mr. Hay has reported at some length on the development of water power for industrial purposes. The following are the schemes reported on:—Kaituna and Huka (Auckland district); Tauherenikau and Hutt (Wellington); Clarence, Coleridge and Opihi (Canterbury); and Teviot (Otago). Any scheme can be carried to full development with little loss. For partial development it would be essential, to avoid future loss, to lay down full size conduits in the first place, as they could not be subsequently enlarged without interrupting working for a considerable period. This means large initial outlay; and in view of the fact that the total power available could not be fully utilised at first, some of these schemes do not appear to warrant such outlay. Details are gone into, and, in regard to the Kaituna, we note that Mr. Hay advocates the erection of two power stations to utilise the available power, which stations, combined, would develop about 50,000 H.P. on the turbines. Any of the larger Kaituna schemes would deliver energy in the Auckland, Thames and Waihi districts at lower rates than the Huka schemes, by 15 per cent. at Auckland and by 20 per cent. at Waihi. For large and continuous supplies to Auckland a charge of £5 10s. would give a good return, and one of £4 10s. to Waihi would be profitable. These are the extreme minimum rates. In regard to one of the Huka schemes, turbines with vertical shafts would be necessary, unless excessive excavations were made. The power obtainable would be about 22,000 H.P. This scheme, completed with transmission lines to serve the Auckland district only, would cost about £615,000. To develop half the available power would cost something like £325,000. If the water were all conserved and necessary dams, &c., constructed, 70,000 H.P. could be developed, but for continuous working, 38,000 H.P. would be the probable limit. The low fall at Huka would entail much more expensive plant per horse-power than in the case of higher falls, and this, with the long-distance transmission, would increase the cost of power obtained from here. The cost for a continuous supply to Auckland is put at £6 10s. per horse-power per annum.

THE N.Z. EXHIBITION.—The machinery exhibit comprises four classes—gas engines, electrical machinery, motor-cars and machine tools. We are pleased to learn from a local source that the electrical machinery is wider in its distribution than anything else in the Machinery Hall. The principal electrical exhibit consists of two generating sets used in connection with the lighting of the exhibition. The aggregate horse-power of these is 250, and they are both intended for use at Timaru.

South Africa.—EAST LONDON.—Our Cape correspondent writes:—The Military Tournament held on December 26th and 27th, was illuminated by enclosed arc lamps and a number of incandescent lamps supplied from the tramways at 500 volts direct, temporary overhead mains being run from the tram terminus at Upper Oxford Street. Owing to the great demands of the tram service on the D.C. supply, it was found necessary to boost the voltage at the terminus by a motor-generator, the motor being connected on the alternating system. Dwelling in tents on the Beach is a great feature of the Christmas holidays here, and the department connects incandescent lamps in tents at a charge of 6d. per day per lamp.

KIMBERLEY.—At a large fire in Lower Jones Street recently, the overhead portion of the telephone system, which was only recently constructed, suffered considerably, the wires in falling coming in contact with the tramway trolley wires. The traction current was thus carried into the premises of telephone subscribers, causing several additional fires. The wires burnt the fire hose and electrocuted several dogs.

South America.—BUENOS AYRES.—The Cia. Alemana Transatlantica de Electricidad has, according to the *Review of the River Plate*, purchased 33,800 sq. metres of land at a cost of $385,000 M/n. On the site the company proposes to erect a power station of a capacity of 120,000 H.P. Our contemporary states that the contract for the boiler plant has been placed with Messrs. Babcock & Wilcox.

South Lancashire.—We learn that the Clifton and Kersley Coal Co., a well-known colliery concern owing several collieries between Manchester and Bolton, has generously offered to affix brackets (for lighting) on the tramway standards of the South Lancashire Tramways Co.'s new line from Unity Brook, Kersley, to Newtown, Pendlebury. The tramway company was not required to light this particular route.

Southampton.—The following new scale of charges for energy for power has been adopted by the Electricity and Tramway Committee:—Less than 200 units per H.P. per quarter, 2d. per unit; over 200 and under 250, 1¾d.; over 250 and under 300, 1½d.; over 300 and under 350, 1¼d.; beyond, 1d.

The T.C. is recommended to apply for a loan of £17,000 for the provision of additional plant at the electricity works.

Windsor.—The Windsor E.L. Co. has offered to install the E.L. at the Workhouse for £108 10s., and to keep the installation in proper repair, on a five years' contract, for £15 per annum. The cost of energy per year at 7d. and 3d. per unit is estimated at £84 17s. 3d., a considerable saving on the cost of oil lighting.

TRAMWAY and RAILWAY NOTES.

Bacup.—The Bacup Corporation Electricity Committee has resolved that the Rawtenstall Corporation Bill for powers to reconstruct and electrify the Bacup tramways be opposed in the next session of Parliament. The portion of tramways in Bacup township measures 2 miles 3 furlongs, and is a very lucrative section.

Canada (WINNIPEG).—A group of local capitalists are about to float a company under the name of the Suburban Electric Railway Co. with a capital of $5,000,000. The promoters propose to build 800 miles of road, tapping Lake Winnipeg on the east side and offering facilities for developing several new summer resorts, as well as giving promise of rich freight traffic in wood, fish, and other commodities. It is generally believed that New York capitalists are behind the project.

BARRIE (Ont.).—The municipality has arrived at an agreement with the Nicholls Electric Railway Syndicate whereby the town is to get a full freight and passenger connection with the C.P.R. at Grenfel or Midhurst in return for a 25 years' franchise, which the town will give to the syndicate on certain terms. Under the terms of the agreement the syndicate is to have exemption from local taxation. It is expected that the by-law authorising this agreement will receive the support of the ratepayers at the forthcoming municipal elections.

Continental Notes.—ITALY.—The electrification of the following existing railway lines has been approved by the Government:—

Milan District.—Milan-Monza-Lecco, £144,000; Usmate-Bergamo, £56,000; Calolzio-Ponte San Pietro, £20,000; Gallarate-Arona, £88,000; Gallarate-Laveno, £104,000; Domodossola-Iselle, £96,000.

Naples.—Naples-Salerno and branches to Torre Annunziata-Castellamare Stabia, £200,000.

Genoa.—Railway round the City, £40,000; Pontedecimo-Busalla, £174,400.

Florence.—Pistoia-Porretta, £320,000.

Turin.—Savona-San Giuseppe, £140,000; Bardonecchia-Modane, £168,000.

ALSACE.—A scheme to establish a system of rail-less trolley cars in the town of Mulhouse, is at present under consideration.

Dudley—Tipton.—The electric tramway from Dudley to Tipton was reopened for passengers on Saturday last week after re-equipment. For a great many years this section of the Black Country tramway system was worked by steam, but about 18 months ago the line was closed, with the result that great inconvenience was caused to both Tipton and Dudley residents, as between the Tipton Green part of the parish and Dudley the only means of communication, other than by walking, was cut off. At present the new service is open only as far as Princes End, a 2d. stage. Beyond the terminus—at Gospel Oak—a difficulty has arisen in respect of the subsidence of the road through mining operations. The reconstruction for the electrical equipment of the line in the direction of Ocker Hill and beyond is in progress, and with the connecting up of the section at Gospel Oak—a difficulty which, it is believed, will be overcome in the near future—through tramway communication between Dudley and Wednesbury will be restored after a discontinuance of two-and-a-half years. It may be added that with the opening of the Tipton line, which was hailed with the liveliest satisfaction, there are now seven distinct electric tramway routes converging on Dudley.

East Ham.—A conference is to take place between representatives of the T.C. and the Barking T.C. in regard to the light railway lease and various points at issue. An arrangement has been come to, for 12 months, for inter-running between the East Ham and West Ham tramways from High Street, East Ham, to Stratford Broadway.

Edinburgh.—The city is still engaged in the discussion of tramway matters. The Tramway Committee recently reported to the T.C. upon the different systems which it inspected in December last. The lessees stipulated that the Mound route should be electrified, and the portion between Tollcross and Gilmore Place adapted for both electric and cable traction; that the Corporation should pay the whole cost of electrifying the Mound route, and adapting the Tollcross section; and that the lessees pay 7 per cent. upon the cost of electrifying the Gilmore Place route by the overhead system, even if any other system is adopted. It was recommended that the Council should convert the route from the Mound to Tollcross to the electric conduit, and from there and along Gilmore Place to the city boundary to the overhead system. Another suggestion was that the "G. B." surface-contact system should be installed; this was out-voted. The Committee agreed to the construction of a further section of route on the cable system, and to a small section on the overhead system, the two latter being on the Leith side of the city. We understand that it is proposed to adopt a single-pole conduit system, suggested by Dr. Kennedy, the existing small cable conduit and light rails being adopted. That this should be seriously considered, after the adverse experience with the large, much better drained, and far more costly system installed in London, where weather conditions are much more propitious, is possibly in keeping with the chaotic conditions outlined above.

Glasgow.—At a meeting of the T.C. last week, a long discussion took place over the proposal of the Tramways Committee to build 100 new cars. Mr. Battersby objected to the recommendation as it involved an expenditure of £60,000, and would mean the augmentation of the wages bill for the additional motormen and conductors required to work them by £13,000 or £14,000 a year. There was no question about the extravagance which was going on, as they found from the last annual report that after all deductions had been made only £36,000 was left. If they went on at the present rate they would fall even below that margin. Before the cars were built inquiry should be made as to the electrical power at their disposal. Treasurer Stevenson seconded, but for different reasons. He did not think that the Tramways Committee was the best judge of what was a good type of car. In Hamburg and Vienna and other big cities on the Continent, they had much larger cars than in Glasgow. He thought that the question should be considered of constructing cars on the bogie system, as had been done by the L.C.C. In regard to the top deck-covered cars, he spoke of the oscillation, and said that if passengers on the car were few in number it "rocked like a ship in a rough sea." Mr. Mason argued that all the new cars should be top-covered. Bailie Russell pointed out that bogie cars could not negotiate the present curves! Bailie Scott advocated bogie cars to hold 120 passengers. Mr. McFarlane, in referring to what other municipalities had done, said that only six months ago the entire tramway system of Birmingham came into the hands of the Corporation, and it had 65 miles of double track compared with 86 in Glasgow and had 720 cars. The Glasgow Corporation had stated that its requirements would only be met by something like 11 cars per mile. At present Glasgow had only nine. Twenty bogie cars had been built for Birmingham, but at present that municipality had at least 100 under construction that were not of the bogie type. In Glasgow they had now reached such a condition of things that they were in a 5 per cent. worse position as to the number of cars than they were three and a half years ago. The Committee had to take on an extra number of men to turn out the cars at the rate of three per week, so great was the pressure. Surely it was desirable that it should start at once to make up what was considered the normal quantity of cars. As far as the capital of the undertaking was concerned, he pointed out that up to date the expenditure was within £3,000,000, and they had reduced the amount of borrowed money by one-half. The Committee's recommendation was approved by a large majority.

Handsworth.—The Tramways Committee has reported that the B. of T. has renewed the licence for the cable cars until April 5th next, the date upon which the consent of the Council to the use of cable traction expires. The Committee also has urged the Council to request the tramway company to increase the speed of the cars.

Hastings.—Considerable dissatisfaction exists in the town with the tramways on the front, which have recently been installed on the Dolter surface-contact system. A local paper, commenting editorially on the matter, says there would be little to complain of *if* there were no flashes due to bad collection, no need for continually crow-barring cars past dead studs, no blinking of the lights and no clatter of the skate on the studs. Our Hastings contemporary is surely getting fastidious; we, in common with many others, are anxiously awaiting an opportunity to see a Dolter car running. We may add that the Dolter Co. blame the uneven paving of the track; the latter was laid by the local tramways company, who also equipped the cars. This, however, hardly accounts for dead studs.

London.—L.C.C.—Without consideration of the exorbitant outlay required for the conduit system as likely to affect them in the least, some of the inhabitants of districts where the L.C.C. desires to lay down tramways continue to protest against the overhead system. Meetings have been held at which resolutions have been passed asking the local authority to refuse to consent to any system using overhead wires.

The Council at Tuesday's meeting postponed for a week the consideration of a recommendation to sanction an expenditure of £26,453 for the installation of the overhead trolley system between Beresford Square, Woolwich, and Plumstead.

LAMBETH.—The B.C. has decided to object to the regulations and by-laws proposed to be made by the B. of T. in regard to increasing the maximum speed of tramcars in the borough from 12 to 16 miles an hour, and on curves from 10 to 12 miles an hour.

Manchester—Oldham.—A through service of electric cars has this week been inaugurated between Manchester and Oldham. There was a ceremonial opening on Monday, in which representatives of the two municipalities took part. The inhabitants of Oldham—to whom the opening is of importance—were present in large numbers. The parties from Oldham and Manchester met at Hollinwood. Manchester has for some time had running powers through the intervening district of Failsworth, and the through connection marks a new, and doubtless profitable, era for the tramway undertaking. The Lord Mayor of Manchester was invited to cut the white tape which spanned the highway at the boundary of Oldham; and the chairman of the City Tramways Committee, in the course of a short address, said the line would add another eight miles of single track to the 162 miles run over by Manchester cars, making 170 miles. Manchester would soon be able to convey Oldham people from Waterhead, through the city, to Altrincham, a distance of 18 miles, without changing cars. The city of Manchester now covers 60 sq. miles, and 18 towns and urban districts, and serves over one million of population, with her tramway system. The connection with Oldham, Mr. Wainwright stated, marked a change in the Committee's policy. Hitherto they had practically had no exchange of through running with other corporations, but they hoped before the year was out that they would have come to terms with Salford, so that Salford and Manchester people might be able to reach railway stations and other places without changing cars. Oldham had adopted weekly tickets and contracts, with great convenience to her people and profit to her revenue. He hoped the Manchester Corporation would—in fact, he might say that next April they meant to—follow to some extent in Oldham's footsteps and provide workmen's weekly tickets. The agreement between Manchester and Oldham for interchange of traffic would be a great public convenience and add strength to the two tramway undertakings. The Mayor of Oldham (Dr. Gourlay) welcomed the Manchester representatives and reciprocated the wish expressed for the prosperity of the joint undertaking. The Manchester cars proceeded to Waterhead and returned to the Oldham Town Hall, where tea was served. The cars were illuminated at night.

New Zealand.—DUNEDIN.—In consequence of a dispute the Arbitration Court has fixed the rate of wages for tramway employés as follows:—Motormen and gripmen, 1s. an hour; conductors, 10½d.; firemen, track repairers, overhead men, ropemen, and linesmen, 1s. each; car examiners, 12¾d.; track cleaners, 11¼d.; all general labourers, including car cleaners, 10½d. The chairman of the Conciliation Board is empowered to fix the rate for under-rate workers. Hill tramways are subject to a special agreement,

under which wages are fixed at 10s. a day, and on Sundays the men are paid 10s. for the first eight hours, and 1s. 6d. an hour thereafter. Motormen will earn about £148, or with overtime £160 a year; conductors £130, or with overtime £140 a year. It is understood that the award governs the wages of tramway employés in other centres.

TAKAPUNA.—The Waitewata C.C. has agreed to terms offered by a syndicate for an option to construct electric tramways within the district. The Council will have the option of taking over the undertaking at the end of 30 years.

AUCKLAND.—The strike which we noted in these columns as having taken place on the tramway system some time ago has been finally settled, on the understanding that before any employé is dismissed he shall be allowed to state his case before the general manager. The matter seems to have created considerable excitement in the colony. A conference of delegates from the tramway unions of Auckland, Wellington, Christchurch, and Dunedin has been held in Wellington to draw up a basis for the federation of the four unions. The object is with a view to the "general betterment" of the tramway employés in the four centres of the colony.

In regard to the question of the percentage of profits to be paid to the Council by the Auckland Electric Tramways Co., it appears that the Council is dissatisfied with the methods adopted by the company. The Council contends that the sum for depreciation should not be set aside until its interests have been considered. The basis of car-mileage in the city and suburbs is also not considered a satisfactory one to the Council on which to base its share of the profits.

Rawtenstall.—It has been decided to demand a poll of ratepayers on the question of the purchase and electrification of the tramways, and the necessary petition is being prepared. In the Lumb Valley portion of the borough dissatisfaction prevails, and it appears that, unless the Corporation decides to extend the lines up Lumb Valley, the scheme will be opposed.

At a town's meeting on Tuesday last week, a resolution was passed authorising the Corporation to proceed with its Bill for the reconstruction and electrification of the tramways.

South Australia.—Not only has the Bill empowering the Government to purchase and electrify the whole of the Adelaide tramway system passed through both Houses of Parliament, but an important addition has been made. The Railway Commissioner has been able to get a clause added which gives him power to electrify any of the existing railway lines under his control. The Adelaide tramways now consist of 30 miles of double track. The track will, it is estimated, cost £120,000; another sum of £120,000 is allowed for overhead construction and equipment, £5,000 for the erection of a power house, £25,000 for equipment of the same, and 150 cars are to be obtained at a cost of £1,000 each.

West Ham.—A provisional settlement has been arrived at between the Council and the North Metropolitan Tramways Co. in connection with the acquisition by the Council of the company's undertaking, whereby the company is to accept £1,478 in payment of its costs. Top covers are to be fitted to 20 cars.

TELEGRAPH and TELEPHONE NOTES.

Birmingham.—There was a partial breakdown of the telephone system last week, due to the fusing of one of the large cables on the 12th inst.

Cuba—United States of America.—A decree has been issued by the Provisional Governor, granting a concession to the Commercial Cable Co., of Cuba, an American organisation, to lay submarine cables between the continental coast of the United States and Cuba, and to work and maintain a cable service between those countries from January 10th, 1907.—*B. of T. Journal.*

Glasgow.—At a meeting of the National Telephone Society for Glasgow and the West of Scotland, an address was delivered by Mr. J. R. Brown, contract agent for Glasgow, on "Contract Department Working." He stated that there were 29,465 telephones working in Glasgow, an increase of 17,648 during the past three years. This worked out at 128 telephones to every 1,000 of the population, and in this respect Glasgow occupied the foremost place amongst the cities of the United Kingdom.

Indian Telegraphs.—The recent report of the Indian Telegraph Department enables us to read with interest a memorandum drawn up by the Committee of the Bengal Chamber of Commerce on certain items which, from the business man's standpoint, are in need of improvement. The memorandum commences by drawing attention to the charges and certain anomalies in the rates which result in the curious condition that, for a long message, the charge is less if it be split into several telegrams than if it be sent as one. For urgent messages the minimum charge is 2 rupees for 16 words, and 4 annas per additional word. Considering the distances over which a telegram may have to be transmitted, the charge for the message does not appear to be excessive, though the extra word tariff does. Ordinary messages cost 1 anna per word for 16-word messages, and 2 annas per word for extra words. The Committee also wishes to urge a reduction of the rates for foreign telegrams.

A number of suggestions have been received from leading mercantile firms for the introduction of a system of deposit accounts, permitting firms of good standing to open two accounts—one for foreign and one for inland telegrams. The telegrams sent against these accounts would be entered in a book, similar to a bank pass-book, to be brought by the messenger with the telegram. This system might be convenient to the business house, but it is questionable if the department could reasonably undertake the extra clerical work involved. Some such device as the issue of books of telegraph forms, with counterfoil for number of words and date of dispatch, might be adopted.

The necessity for signing twice in connection with each telegram dispatched, in consequence of the new guarantee which has to be given with reference to code words, is found to cause great trouble and inconvenience. This would be obviated by the use of books of forms before alluded to.

Railway telegraphs, it is said, should be taken over by Government to ensure better working. Complaints of delays in delivery, transmission, repetition, &c., and of inaccuracies and mutilations, are numerous.

As will be seen, with the exception of, perhaps, the last clause, no very serious complaint is brought forward. The memorandum is, however, well worthy of the attention of the department as an indication of the lines along which improvements may be instituted for the benefit of the community.

Lighthouses and Lightships.—The Committee of the Liverpool Underwriters' Association reports that considerable progress has been made in the utilisation of submarine signalling, by which vessels equipped with the apparatus are able to ascertain their position with reference to the point from which the bell warnings come. Many vessels and lightships are at present fitted with the apparatus, and a wider adoption of this aid to navigation would considerably increase the security of life and property at sea. The Mersey Docks and Harbour Board have decided to install the wireless system of communication on the North-west Lightship, and the question of similarly equipping some of the Board's shore stations is being considered. The North-west Lightship is already provided with the submarine signalling apparatus, which is, so far as the Committee are aware, the first permanent application of that system of signalling to any lightship in home waters. Fifty-one lighthouses and light vessels are now connected electrically with the telegraphic system of the United Kingdom, and the Committee trust that during the ensuing session of Parliament opportunity will be taken by the Government to obtain powers to arrange for the whole of the lighthouses and light vessels to be electrically linked with the shore stations, so that the earliest possible notice may be given to the coastguard or lifeboat officers of wrecks or other casualties in their neighbourhood.—*Standard.*

Marine Insurance and Wireless Telegraphy.—The question of the importance of wireless telegraphy to insurance, especially marine insurance, was discussed in a paper by Herr Nairz, presented at a conference of the Association for Insurance Science held in Berlin on January 15th. After pointing out that premiums had constantly declined since the earth was surrounded by an extensive network of submarine cables, the author suggested that a similar movement would presumably also take place to a large extent, owing to the operation of radio-telegraphy and radio-telephony. By the agreement concluded at the Berlin conference stations were compelled to give preference under any circumstances to calls of distress from ships at sea. By means of numerous examples the author showed how frequently pleasure steamers had been requisitioned by wireless telegraphy to render real assistance, and he stated that the risk was more favourable with ships equipped with apparatus of this kind. It was only due to the conservative character of shipowners that the majority of vessels were not already provided with installations. A few thousand marks were saved, whereas hundreds of thousands might be lost under certain circumstances. He concluded by predicting that it was only a question of time before every vessel would be equipped in this way.

New Zealand.—The Austrian Consul at Auckland, in a recent report, states that there are in New Zealand 1,887 post offices, and 13,424 telephone offices; there are 7,944 miles of telegraph line, with 23,704 miles of wire. The utilisation of wireless telegraphy between New Zealand and Australia is still in project; the Postmaster of New Zealand, Sir Joseph Ward, after leaving the Conference at Rome, decided to visit the United States in order to study the several systems and their results. The Australian director of the International Telegraph Construction Co., which uses the Schoemaker system, has laid before the Postmaster the advantages of this system for use in Australia and New Zealand, with proposals as to the places in these two countries where stations could be erected. The Wellington Chamber of Commerce has applied to the Government for the installation of telephonic or wireless telegraphic communication between the Cape Palliser lighthouse and the mainland.

Telephone Agreements.—In the City of London Court last Friday an action was brought by the P.M.G. against Mr. F. C. Nash, Culford Mansions, Cadogan Square, to recover the sum of £7 9s. 9d. for telephone charges due in advance. The defendant's telephone had been disconnected. Judge Lumley Smith said he felt he must give judgment for the Postmaster-General, with costs, but the defendant would have every opportunity to appeal.

Switzerland.—The Swiss telephone system had in 1905, according to the last return, increased to over 252,235 kilometres of line, and the number of subscribers to 50,333. By comparison with the various European States, Switzerland occupied in 1904 the first place for the number of telephone offices per square kilometre, as she had more than one per square kilometre. Spain, by the same comparison, was last. From the point of view of number of inhabitants, Switzerland occupies fourth rank, with one station for every 64 inhabitants. In front of her are Sweden (1·47), Denmark (1·52) and Norway (1·59).

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Paramaribo-Cayenne	Nov. 27, 1906	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Guadeloupe-Martinique	Aug. 29, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed.	Jan. 12, 1906	
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Port Arthur-Chifu (Closed)	Mar. 9, 1904	
Garachico-Santa Cruz	July 12, 1906	
Las Palmas-Arecife	Aug. 18, 1906	
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	
Fao-Bushire	Dec. 4, 1906	
Martinique-Paramaribo	Dec. 17, 1906	
Gibraltar-Tangier	Jan. 2, 1907	
New Brunswick-Prince Edward Island	Jan. 9, 1907	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Soukhoum Kale-Tifles	Jan. 17, 1907	Jan. 17

Wireless Telegraphy.—The Eiffel Tower seems to be specially adapted for the purpose of a wireless telegraph station. Recent experiments have enabled constant communication to be kept up with the eastern frontier of France by its means, and messages have been sent to Berlin. It is now proposed to establish regular communication between the two capitals, using the Tour Eiffel as the French station. Messages have already, it is stated, been exchanged with Poldhu (Cornwall) on the one hand, and with Porquerolles and Port-Vendres on the other hand, and as soon as some new apparatus, now in course of construction, is completed, it is hoped to establish regular communication with Algiers.

CONTRACTS OPEN and CLOSED.

OPEN.

Adelaide (Victoria).—March 6th. The *Board of Trade Journal* states that tenders will be received at the office of the Deputy Postmaster-General at Adelaide for the supply of telegraph and telephone material, including 500 transmitters, 3 miles of cable, 20 miles of copper wire, &c. Specifications and samples can be seen, and forms of tender obtained, at the General Post Offices, Adelaide, Melbourne, Sydney and Brisbane. The *Commonwealth Gazette*, which contains a complete list of the material required, may be seen *by British firms* at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Belfast.—February 11th. Boilers, superheaters, stokers, &c., for the tramways and electricity department. See "Official Notices" January 18th.

Belgium.—March 30th. The municipal authorities of Liége are inviting tenders for the establishment and working of a large central electricity station for the generation and distribution of electrical energy in the Liége district. Particulars and copies of the plans may be obtained for 27 francs from the Chef du Bureau Administratif des Travaux (Annexe de l'Hotel de Ville), and tenders are to be sent to Le Secretariat, Hotel de Ville, Liége.

Berlin.—February 20th. The Prussian Government Railways requires tenders for 94,800 insulators and accessories, 86,900 kilos. bronze wire, 467,750 kilos. galvanised wire, 1,950 kilos. copper wire, 8,500 insulated wire, 1,000 kilos. cable for bells, &c. Particulars may be obtained by enclosing 6d. to the Director Eisenbahn Telegraph Amt.

Bermondsey.—February 6th. Carbons, conduits, meters, cables, &c., for the electricity and destructor department of the Council for one year. See "Official Notices" January 11th.

Cannes.—January 31st. The municipality announces that the gas and electric concessions terminate on August 31st, 1908. Although these companies have the right to supply, without monopoly, private consumers until 1935, they are prepared to receive tenders from those desirous of obtaining one or both of these concessions, separately or together. Offers should reach the Secretariat de la Mairie before January 31st, 1907.

Copenhagen.—February 11th. The Government Railways Department requires tenders by February 11th for 17 automatic centrifugal pumps with electromotors. Specifications may be obtained for 20 kroner (1s. 1½d.) at the office of the Administration.

Copenhagen.—March 18th. Two steam turbine alternators (three-phase), 2,500 kw. each, for the Corporation. See "Official Notices" to-day.

Darlington.—February 8th. One 500-kw. dynamo and engine for the Corporation. See "Official Notices" to-day.

Dublin.—January 29th. The Dublin Port and Docks Board requires tenders for electrical pumping machinery and electric wharf cranes. Particulars from Mr. John P. Griffith, engineer to the Board, East Wall, Dublin, on payment of £1.

Eastbourne.—February 11th. One 750-kw. steam turbo-alternator and condensing plant for the Corporation. See "Official Notices" January 18th.

Edinburgh.—Condensing plant for the Corporation electricity supply department. See "Official Notices" to-day.

Edinburgh.—February 18th. Exhaust steam turbines and d.c. generators for the electricity station in M'Donald Road. See "Official Notices" to-day.

France.—January 31st. A public adjudication will take place on February 9th at the Prefecture of the Seine et Oise, at Versailles, to sell to the highest bidder the concession for a tramway from Montmorency to Enghica, a famous watering place and summer resort near Paris, and Shirot Gertien. Application of intending tenderers must be made before January 31st.

Hammersmith.—February 6th. Stores for the electricity department for one year. See "Official Notices" to-day.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Leith.—February 6th. One 600-kw. steam dynamo and one water-tube boiler for the Corporation electricity department. See "Official Notices" to-day.

Middlesex.—February 13th. The Light Railways and Tramways Committee of the County Council is inviting tenders for the construction of some miles of double track for electric traction along Harrow Road, and at Willesden and Acton. Mr. H. T. Wakelam, M.I.C.E., County Engineer, Middlesex Guildhall, Westminster, S.W.

Newport (Mon.).—January 31st. The Guardians invite tenders for installing electric light at Springfield House. Clerk to the Guardians, Union Offices, Queen's Hill, Newport, Mon.

Rathmines.—January 30th. Supplies for the U.D.C. electricity works. See "Official Notices" January 18th.

Salford.—February 9th. One motor for driving a 150-kw. alternator for the Electricity Committee. See "Official Notices" January 18th.

Sheffield.—February 6th. Tramway stores for the Corporation. See "Official Notices" to-day.

South Australia.—March 6th. The Postmaster-General requires tenders for telephone and telegraph material. For particulars see our issue of January 18th.

Spain.—The Municipality of Braga wants tenders for the construction and working of electric tramways. A deposit of about £1,125 is needed in order to qualify any tender. The contract conditions (in Portuguese) may be inspected by British firms at the offices of the Commercial Intelligence Branch of the Board of Trade, in Basinghall Street, E.C.

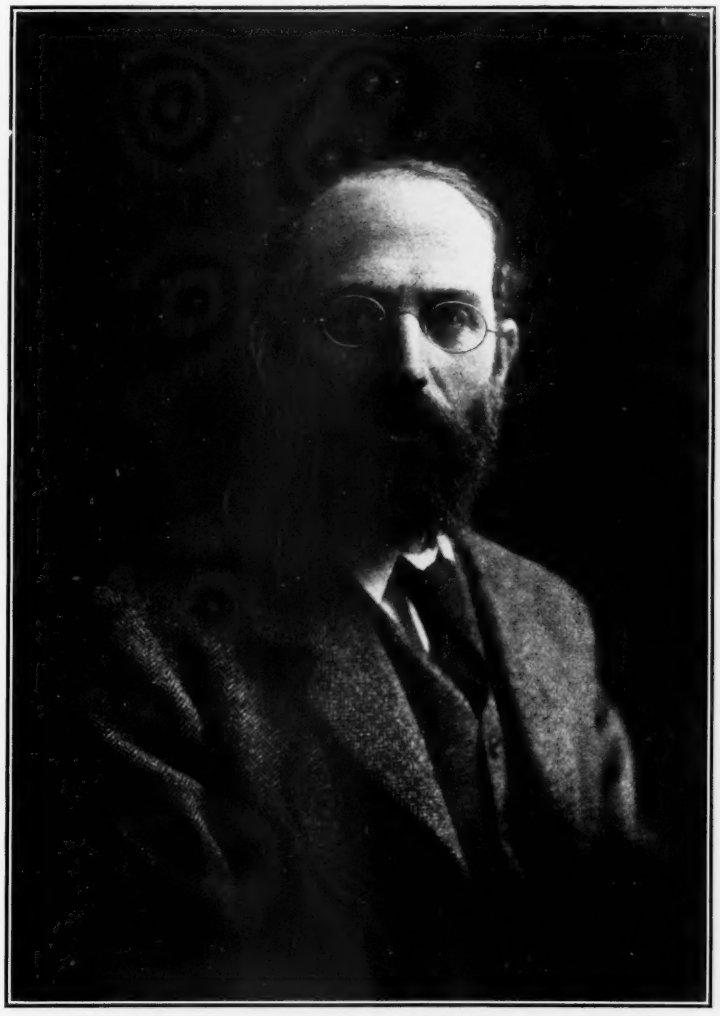
Spain.—Tenders have just been invited by the municipal authorities of Dos Barros (province of Toledo) for the concession for the electric lighting of the town during a period of 15 years.

(*Continued on page* 151.)

PROF. A. SCHUSTER, Sc.D., Ph.D., F.R.S.

Arthur Schuster was born on September 12th, 1851, at Frankfort-on-Main. He was educated at a private school, and at the Gymnasium, at Frankfort. At the age of 17 he entered the University of Geneva, where for two years he studied science, attending the lectures of Soret, Marignac and Plantamour. In 1870 he came to England, and entered his father's business at Manchester.

His natural love of science, and the fame of Sir Henry (then Prof.) Roscoe, attracted him to attend the evening classes at Owens College in its old buildings in the city. A year later the passion of the investigator had so possessed him, that he decided to renounce a business career, and entered the College as a day student, the same year publishing his first piece of research work, "On the Spectrum of Nitrogen." He proceeded then to study for two years at Heidelberg, at the laboratory of Bunsen and Kirchhoff, the fathers of spectroscopic research. After graduating Ph.D., he returned to Manchester as demonstrator under Balfour Stewart. In 1881 he was appointed to the chair of Applied Mathematics, and on the death of Prof. Stewart, seven years later, to the Langworthy Professorship of Physics, which he resigned a few weeks ago.



Professor Arthur Schuster, F.R.S.

The quarters then assigned to physics in the College buildings soon became much too small to accommodate the students entering the courses, and in 1900 the magnificent new physical laboratories, to whose design Prof. Schuster had devoted much time and thought, were opened by Lord Rayleigh.

The provision for research in these buildings is specially complete. The laboratory for electro-chemistry is fitted with all the appliances necessary for electric furnace work of the most varied character, and on a considerable scale; the dynamo house in the Hopkinson Memorial Wing contains examples of all the most important types of machines, and the specially fine equipment for spectroscopy, a branch of research in which Dr. Schuster is now accepted as one of the greatest living authorities, is probably unique in the world.

Prof. Schuster's services to science have not been confined to his work in physics. He has for a long time been a very prominent member of many public bodies in Manchester, including the Council and Senate of the University, whose charter he was largely instrumental in obtaining.

He has taken an important part in several international scientific conferences, and as one speaker said at a meeting held at Manchester on June 29th last to celebrate the twenty-fifth anniversary of Dr. Schuster's professorship: "If it were possible to hold an interplanetary conference meeting, say, on the planet Jupiter, it is very probable that Dr. Schuster would be asked to act as the earth's representative."

Prof. Schuster has for many years been a Fellow of the Royal Society, where he has twice given the Bakerian Lecture; he is an honorary Sc.D. of Cambridge, has represented this country on many occasions abroad, and has conducted numerous eclipse expeditions. He was the first to photograph the spectrum of the solar corona, and is the author of many papers in the *Philosophical Transactions* and *Proceedings*, *Nature*, the *Astrophysical Journal* and other publications.

Owing to the great amount of experimental work which has been done in recent years on the conduction of electricity through gases, the importance of the pioneering work done by Dr. Schuster in the early eighties is liable to be overlooked. He was the first to base the theory of the process

on the carriage of a definite charge of electricity by the atoms of the gas, and to show how the magnitude of this charge could be measured (Bakerian lecture before the Royal Society, 1884.)

In his second Bakerian lecture in 1890 he gave the result of his method of determining the ratio of the charge to the mass of the atom carrying it by the deflection of the atom from a straight line path in a magnetic field. Both those ideas have played, and still play, an important part in the development of the theory of conduction in gases, and it is well occasionally to call to mind how much they are responsible for the evolution of order out of the chaos which preceded them, and to trace them back to their originator.

The Council and Senate have recorded their regret at Prof. Schuster's resignation, and their appreciation of his very great services to science and to the University. He will be succeeded by Prof. E. Rutherford, F.R.S., of McGill University, Montreal.

Our portrait is from a photograph by Lafayette, Manchester.

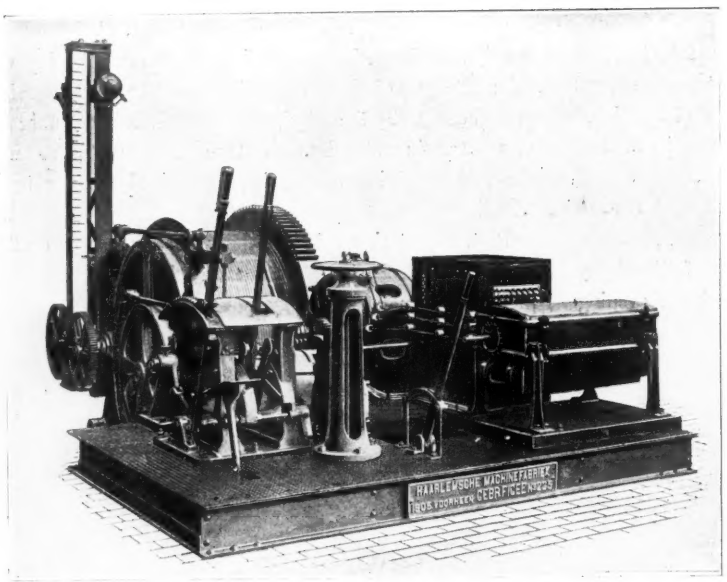


FIG. 1.—WINCH FOR RAISING MATERIALS IN CONNECTION WITH THE SINKING PLANT.

ELECTRICALLY-OPERATED SINKING PLANT.

[BY OUR BERLIN CORRESPONDENT.]

THE electrically-operated sinking plant recently installed at the Wilhelmina Pit of the Dutch State Mining Department, near Haarlem, may be regarded as a typical instance of this class of work. In sinking the shaft by the refrigeration process, it was anticipated that water would be met with, and that sinking pumps would have to be kept in readiness. High-pressure centrifugal pumps, directly coupled to three-phase motors were adopted for this purpose, the electrical plant being supplied by the Siemens-Schuckert Works.

Three-phase plant, working at 2,000 volts pressure, was chosen, the size of the machinery installed in the beginning being determined according to the motors required during the sinking operations

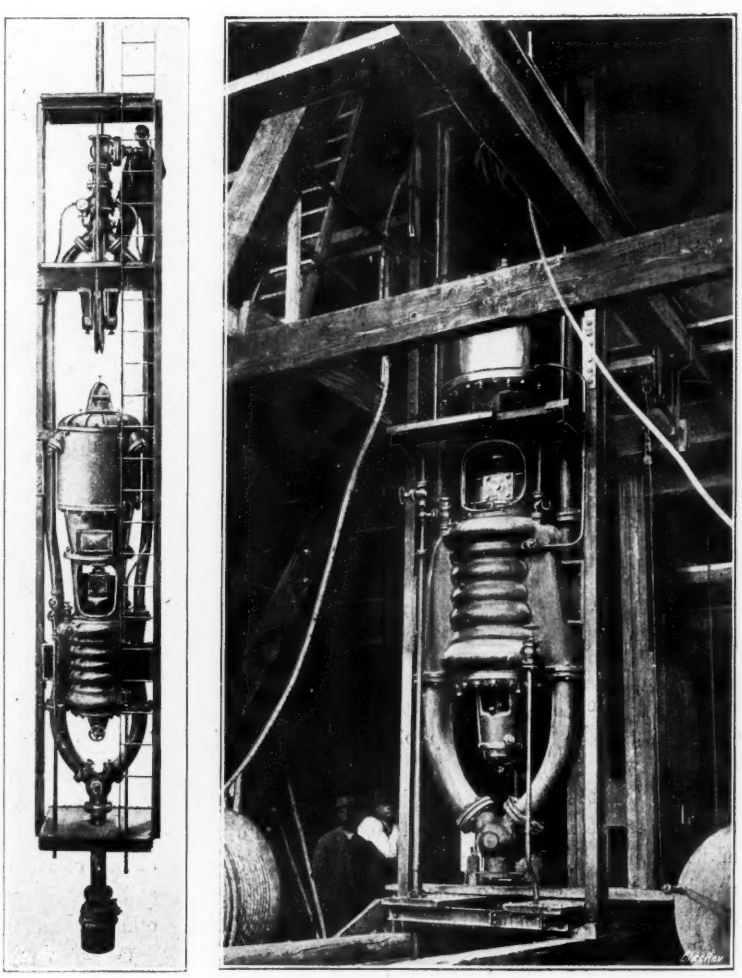
Two three-phase generators of 235 K.V.A. each, and a maximum pressure of 2,200 volts at a speed of 125 R.P.M., were installed, driven by horizontal tandem engines of 300 to 400 effective H.P.

The continuous current required for excitation is supplied partly by the D.C. shunt machines directly coupled to the latter, and partly by a small D.C. turbine unit operated by a De Laval steam turbine, which is also used for feeding the lighting plant above ground.

The direct current machines energise two separate sets of bus-bars, for excitation and lighting respectively; the three-phase bus-bars are also divided into groups, with a view to isolating any particular apparatus.

Automatic regulation of the fields is provided, with a view as far as possible to reduce the duties of the switchboard operator and to render any fluctuations in the load of the motors as harmless as possible.

The main switchgear is installed adjacent to the main generators. The high-tension switchboard with the cut-outs, safety fuses and measuring instruments is installed in a room adjoining the engine room, while the distributing switchgear is situated in a room above the engine house floor level.

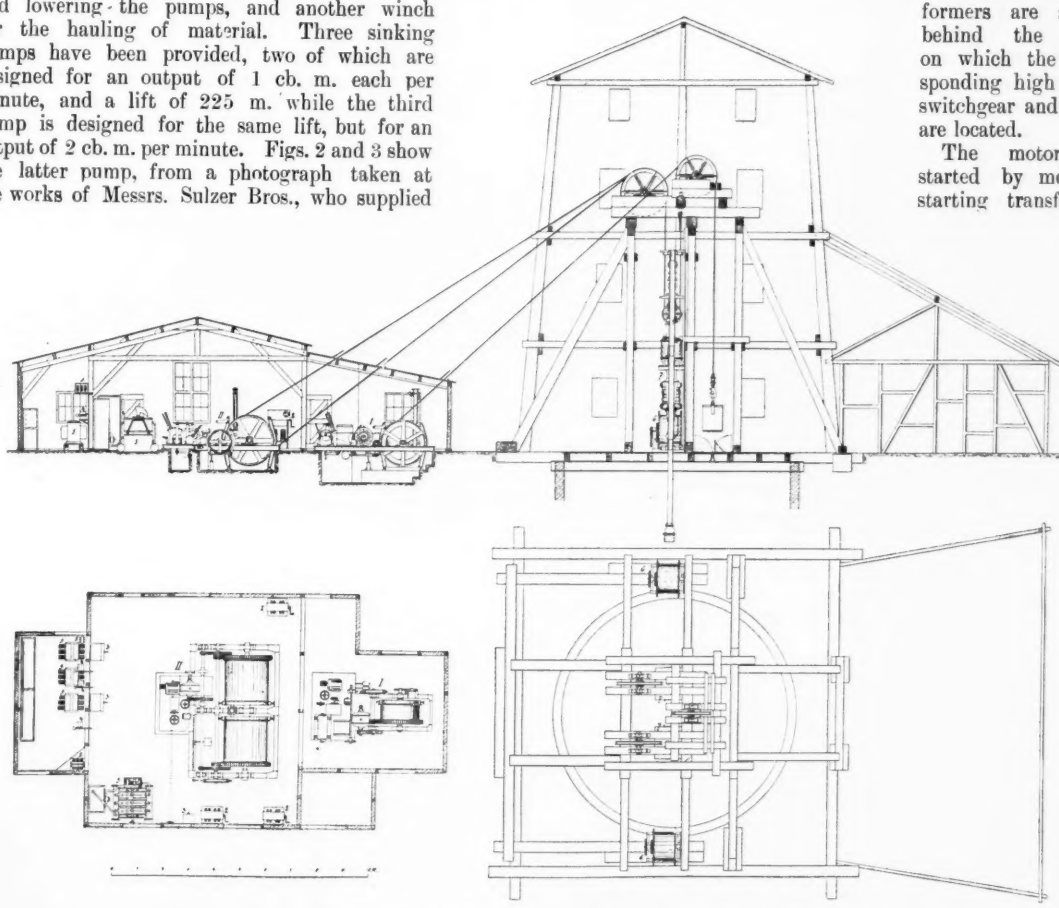


FIGS. 2 AND 3.—SINKING PUMPS.

For the power circuits underground cables have been used. The most interesting of all the apparatus is the sinking plant installed in this pit, which is being duplicated in another pit; this is shown in figs. 4 and 5, and comprises the sinking pumps, the lifting winch for raising and lowering the pumps, and another winch for the hauling of material. Three sinking pumps have been provided, two of which are designed for an output of 1 cb. m. each per minute, and a lift of 225 m. while the third pump is designed for the same lift, but for an output of 2 cb. m. per minute. Figs. 2 and 3 show the latter pump, from a photograph taken at the works of Messrs. Sulzer Bros., who supplied the mechanical part of all the pumps; and suspended in the pit frame with its cable drum.

The pumps are of the well-known Sulzer type, and are operated directly by three-phase motors through flexible clutches. The pressure of 2,000 volts supplied by the power station is transformed down to 500 volts, by three transformers installed in the winchroom. The transformers are situated behind the panels on which the corresponding high tension switchgear and meters are located.

The motors are started by means of starting transformers, the minimum pressure being chosen low enough for the pumps to start with closed water-gauge. The starting current is thus maintained at as low a value as possible.



Figs. 4 and 5.—Showing the Arrangement of the Sinking Plant, Wilhelmina Pit.

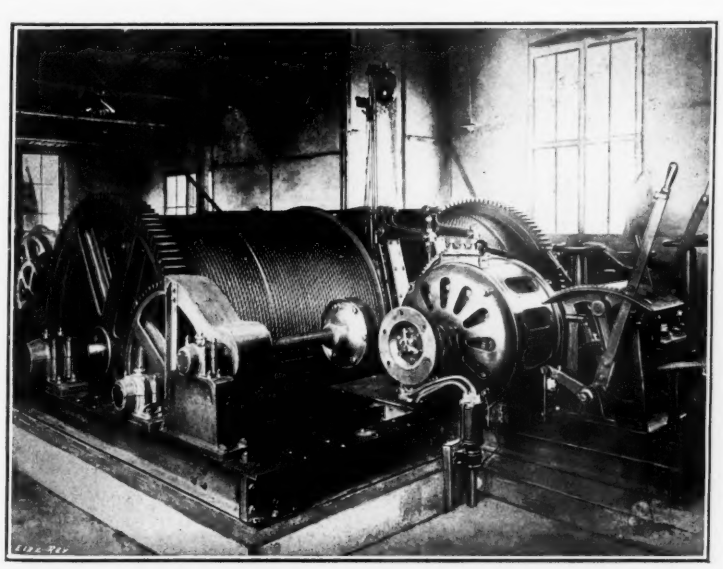
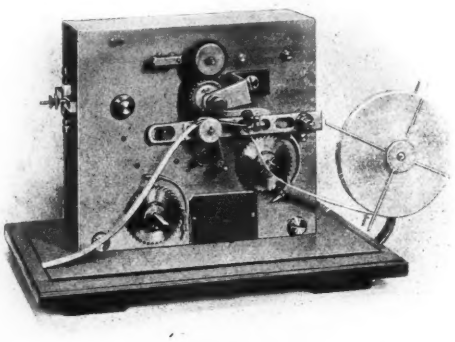


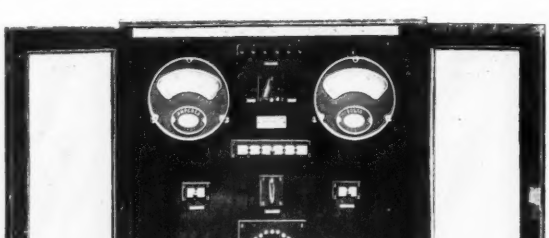
Fig. 6.—Sinking Pump Winch, Wilhelmina Pit.

From the two starting transformers cables are carried to two cable drums, to which they are connected through box contacts arranged on the drums. Each pump is suspended by a rope which is carried under a rope pulley fitted to the upper end of the pump. The rising conductor is placed between the two halves of the rope, and is kept vertical by the aid of wooden pins, to which the cable also is fastened, so as to ensure a safe attachment during the lifting and lowering of the pumps. In the place of lead cables, a special cable has been manufactured by the Siemens-Schuckert Works, with a specially strong armouring and a very carefully compressed rubber insulation.

The pump motors are completely enclosed, owing to the considerable moisture in the pit. In order, however, to carry away the heat generated internally, they are cooled by means of water derived from the lowermost stage of the turbine, which is under a comparatively low pressure. Divisions have been provided in the water jacket in order to cause the water to thoroughly cool all parts of the casing. The interior



Tape-Printing Receiver, Fitted in Offices, Liverpool Cotton Exchange. (See next page.)



Test-Board for Clock Circuits, Liverpool Cotton Exchange.

of the motor is kept thoroughly ventilated by means of fan draught, thus ensuring cool rotor windings.

The pumps are lifted and lowered by the larger of the two winches, which is provided with two drums. Fig. 6 shows this winch, the mechanical part of which has been constructed by the Königin-Marienhütte, at Kainsdorf i. S. Each drum supports one pump. The winch is operated by an 80-H.P. motor through triple gearing. In order to be able to lift each pump separately, each drum is connected to the shaft by a clutch. The drum brakes are very powerful, with a view to ensuring easy manipulation of the pumps.

The three-phase motor driving the winch operates at 2,000 volts pressure; and is controlled by an oil switch separated from the starting resistance, and installed on the driver's stand close to the controller. The controlling and brake levers are inter-locked, the former being free to work only while the brake is lifted, whereas the braking lever is only disengaged when the controlling lever has been moved to its zero position, thus inserting the greater part of the starting resistance.

The latter is of the liquid type, immersed in soda solution, which can be cooled when required, by means of a small pump which forces it through a cooling coil.

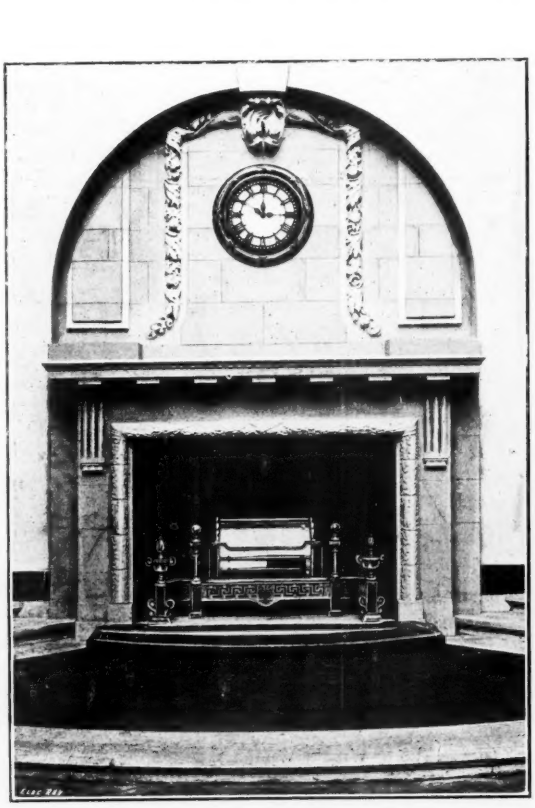
The speed of lifting the pump was not to exceed 0·13 metre per second.

The winch has been so designed that it may be used after the conclusion of the sinking work, in hauling material and conveying the men, when the rope speed can be raised to 2 metres per second, by coupling the motor direct to the first shaft of the intermediate gearing. The winch will then be able to lift 2,000 kg., for which the motor and starter were originally designed. Between the depth gauge and controller a lever system has been inserted, for throwing the

Typewriting Telegraph Transmitter, Liverpool Cotton Exchange.

controller lever and braking lever into their zero positions as soon as the lifting path has been traversed, and applying the safety brake when the cage has run beyond its limit.

The other winch represented in fig. 1 is provided with only one drum, and is used for hauling purposes. The mechanical part of this winch has been constructed by the Haarlem Machine Works, for a useful load of 1,000 kg. and a rope speed of 1·8 m/sec. The output of the motor, which is also run on a 2,000-volt circuit, is about 50 H.P. The construction of this winch, as regards the arrangement



Bronze and opal dial clock.

Clock with controlling pendulum.

Electrical Clocks at the Liverpool Cotton Exchange.

and effect of the brakes, design of controller, and mutual interlocking of the braking and controlling levers, resembles the larger winch. The drum brake levers are connected to a small braking magnet, which releases the weight of the brake and throws it into gear, if the supply is interrupted. The electrical part shows no distinctive feature worthy of notice, as compared with the other winch, but the starter has no liquid resistance, and the switch is not separately arranged.

The above particulars are derived from a recent article by W. Philippi, published in the *Elektrotechnische Zeitschrift.*

ELECTRICAL CLOCK AND TELEGRAPH INSTALLATION AT THE LIVERPOOL COTTON EXCHANGE.

The new Liverpool Cotton Exchange, which was formally opened by H.R.H. The Prince of Wales at the end of November, is now in the occupation of the members of the Cotton Association, and we are enabled to place before our readers a descriptive account of the electrical work carried out there by the Private Wire and Telephone Installation Co., Ltd., of 78, Queen Street, London, E.C., under the direct personal supervision of Mr. J. L. Newland, the Managing Director.

We may state that the building, which is said by some to be the finest commercial edifice in the kingdom, and which has been erected at a cost of £350,000, stands on an "island" site, having four frontages.

The work to which we draw attention consists of the Electric Clock and Telegraph Installations. With regard to the former, we may say at once that it is the largest electric clock installation fitted in this country, comprising, as it does, close upon 120 clocks, all of which are driven by the controlling pendulum shown on the opposite page.

In the Exchange Hall are four very handsome bronze and opal dials, 30 in. in diameter, on which, in addition to Greenwich, New York time also is shown; there are also 114 clocks distributed throughout the various offices in the building.

The whole of the clocks being connected in series, it was thought advisable to provide some ready means of testing the circuits, in order to locate any faults which might occur, and to provide some means of cutting out a faulty circuit, while leaving the remainder of the clocks working. To this end all the circuits have been brought to a test board, which we illustrate, and are connected to the multiple plug contact which may be seen on the middle of the board. Normally, with the plugs withdrawn, the clocks are in circuit, but in the event of a fault occurring, the plugs are inserted one at a time until the circuit is complete, thus cutting out the faulty loop. This board, which comprises everything necessary for testing and adjusting such a system, is a fine piece of work, and was made by the Consolidated Supply Co., of Canonbury.

The clocks are working off a primary battery of patent central zinc Leclanché cells, and as the size of the battery depends on the number of clocks in circuit, a multiple switch is provided at the base of the board, which enables the number of cells or the size of the battery to be varied according to circumstances. To effect this, the controlling pendulum is short-circuited by means of a plug shown upon the right-hand side of the board, and the amperemeter thrown into circuit by withdrawing the left-hand plug; the radial switch is then adjusted, so that the current flowing is as near 3 amperes as possible.

Every effort has been made to provide against the possibility of a breakdown; to this end the battery is duplicated, and the two-way switch, seen at the top of the board, enables either battery to be used, the system being thrown over to one battery while the other is being tested, for which purpose a voltmeter, on the test board already referred to, has been provided.

On this board is also furnished a ready means of adjusting the clocks. The advancement of all the clocks half a minute can be easily procured by momentarily introducing the plug into the two left-hand contacts, thereby short-circuiting the controller; while, on the other hand, the insertion of all the plugs into the multiple plug block allows the impulses coming from the controller to go by unheeded until the clocks have been correctly synchronised. The system adopted is that of the Synchronome Co., of London.

The Telegraph Installation consists of a system for telegraphing the prices as they fluctuate "on 'Change," to the various suites of offices in the building, occupied by members of the Cotton Association.

In the Central Exchange Hall, near the blackboard where prices are marked up, an operator is seated in charge of the transmitting instrument, which is operated by a key-board closely resembling that of an ordinary typewriting machine. This instrument can operate almost any number of receiving instruments, and will, for the present, be working 50.

On the transmitter is a continuous tape, on which the message being transmitted is typed, so that the operator can read what he is sending, and correct any error, should such be made.

The instruments in the offices consist of receivers only, and are fitted with continuous tapes on which the quotations transmitted, are received simultaneously in every office in the building. The advantages of such a system to members of the Association will be obvious, and it is expected that similar installations will become common in various exchanges in the country, where it is of such importance for members to be instantly informed of the prices as they fluctuate.

The system, that of the Typewriting Telegraph Corporation, Ltd., "Steljes" patent, is an adaptation of the original "Wheatstone A.B.C." working, with letters and figures direct.

In order to minimise, as far as possible, the chance of a breakdown of the system, the installation is divided into three sections, but all operated by the one controlling keyboard. Two sections are at present complete, and the third will be added as required.

The generator consists of three multiple-magnet magneto machines, with shuttle armatures, giving one complete reversal of current per revolution. The three machines are all coupled on one shaft and driven by a ¼-H.P. motor, placed in the base of the desk, and supplied from the lighting mains. The current collecting brushes for the magnetos are spring controlled and very substantial.

The contact pointer is situated immediately over the magnetos; the vertical spindle being driven from the magneto shaft by worm gearing. The circular type of keyboard has been abandoned, the keys being brought up in stepped rows and arranged in standard typewriter form.

The return current to the magnetos is brought through one platinum contact on the controller, which has a very large area to carry the whole of the current.

The receivers are wired in multiple series circuits of 10 each, each magneto being capable of operating 30. Condensers are connected across the circuit to overcome any inductive effect. These recorders have been much improved during recent years; spring driving is now substituted for the weights, enabling the machine to be wound up while working if necessary.

Each receiver is fitted with two magnets, one having a polarised armature oscillating in synchronism with the alternating line current, and the other lifting the paper when an interruption occurs. The escapement has also been much improved; instead of the double tooth wheel, two opposed crowns of inwardly projecting pins are used, giving a much freer and more certain motion.

The type wheels have been designed to suit the requirements of the Cotton Association, special characters being necessary to meet their particular terms.

The instruments are provided with long flexible cords, attached to differential plugs provided in the wainscotting, and stand upon pedestals or tables; by this arrangement another instrument can be immediately fitted in the event of a fault occurring on the one in use, and in the case of an office being unlet, the instrument can be put away.

The wiring throughout both these installations consists of No. 16 highly insulated V.R. wire, drawn into seamless screwed steel tube, and, approximately 11 miles of wire and four miles of tube have been used on the two systems.

The architects are Messrs. Matear & Simon, of Liverpool, and the building contractors, the Waring White Building Co., who have earned a substantial bonus by completing within two months of the time specified in their contract.

CONTRACTS OPEN.

(*Concluded from page* 146.)

Spain.—January 28th. The municipal authorities of Azuaga (province of Badajoz) are inviting tenders until the 28th inst. for the concession for the electric lighting of the town during a period of 25 years. Tenders are to be sent to El Secretario del Ayuntamiento de Azuaga (Badajoz).

Sydney (N.S.W.).—March 6th. The *Board of Trade Journal* says that tenders will be received at the office of the Deputy Postmaster-General, Sydney, New South Wales, for the supply to the Departmental Stores, Sydney, of 7½ tons of hard-drawn copper wire, 200 lb. per mile. Specification and tender forms may be obtained at the General Post Offices, Sydney, Melbourne, Brisbane and Adelaide. A price at per ton must be submitted. The shortest time in which the wire would be delivered, and the country in which the copper is produced, must be stated. Tenders must be addressed to the Deputy Postmaster-General, Sydney, and endorsed "Tender for copper wire."

Walthamstow.—February 8th. Water-tube boilers, coal-conveying plant, engines and dynamos, condensing plant, water purifying and softening plant, and switchboard extensions for the U.D.C. electricity works extensions. See "Official Notices" to-day.

Warrington.—January 28th. Cables, switchboard panel and transformers, for the Electricity Department. See "Official Notices" January 11th.

CLOSED.

Belfast.—Mr. McCowen, the city electrical engineer, reported to the Tramways and Electricity Committee on 21st inst that he had received tenders from 18 firms for steam dynamos

comprising 53 alternatives for various combinations of engine and dynamo, and 16 tenders for condensing plant. He recommended the tender of Messrs. Willans & Robinson, Ltd., for two 1,000-kw. turbo-dynamos, at £14,956, and next to that the tender of Messrs. Dick, Kerr & Co. for two 1,000 kw. steam dynamos, at £16,846. For condensing plant, he recommended the tender of Messrs. Willans & Robinson, Ltd., at £3,191. The Committee recommended to the City Council, for its confirmation, Messrs. Willans and Robinson's tender for the dynamos and condensing plant at the quoted amounts. The time of delivery is eight months.

Brush Contracts.—The following contracts have recently been secured by the Brush Electrical Engineering Co., Ltd.:—

For Mr. P. J. Mitchell, Westminster, 200-kw. turbo-alternator.
For the Dunlop Rubber Co., Birmingham 300-kw. Brush-Falcon steam dynamo (repeat order).
For the Yarmouth Corporation, four double-deck completely-equipped cars.
For the Accrington Corporation, 19 completely-equipped tramcars and overhead line equipment.
For Messrs. Bruce Peebles & Co. (for Shanghai), 28 cars and trucks (extension order).

Glasgow.—The Tramways Committee of the T.C. has accepted the following offers:—

Scrap vulcanised cable.—Samuel Galbraith.
Brass and copper borings.—R. Hutcheson.
Special work, Argyle and Glassford Street crossing.—Lorain Steel Co.
Pole tops for stopping-place signs.—J. & A. Law.
Armature binding wire.—G. P. Wall.
Carbon brushes for motor-generator.—Crompton & Co., Ltd.
Acme tape.—British Thomson-Houston Co.
2/0 trolley wire.—United States Steel Products Exports Co.
Telephone repair parts.—General Electric Co., Ltd.
Carborundum wheels for buffing machines.—Thos Potter.
Spark plugs for oil switches.—British Westinghouse Electric & Manufacturing Co., Ltd.
Three-pole porcelain fuses.—W. C. Yuille & Co.
Petroleum residuum.—British Paving Co., Ltd.
Shunt coils for arc lamps.—Brockie-Pell Arc Lamp Co., Ltd.
Gear cases.—British Thomson-Houston Co., Ltd.
Westinghouse field coils.—British Westinghouse Electric & Manufacturing Co., Ltd.
Wattmeter and circuit breaker, controller fingers.—British Thomson-Houston Co., Ltd.

The Electricity Committee has recommended for acceptance the following offers for additional plant required in connection with the extension of Port Dundas station:—

Two steam boilers and two sets of mechanical stokers.—Messrs. Babcock and Wilcox, Ltd., £4,015. (The Stirling Boiler Co.'s offer amounted to £3,994.)
Steam turbine-alternator and condensing plant.—Messrs. Willans and Robinson, £14,752—the lowest tender.
Motor-generators.—The British Westinghouse Electric & Manufacturing Co., Ltd., £10,950—the lowest offer which complied with the specification.

The switchboard is to be extended at the scheduled rates in the contracts with Messrs. Ferranti, Ltd., and the British Westinghouse Co. for that work.

Great Yarmouth.—Messrs. Thermit, Ltd., have obtained an order from the Corporation for the welding, by their patent alumino-thermic process, of the extension of the Great Yarmouth tramway system to Caister.

Kingston-on-Thames.—The T.C. has accepted the tender of Messrs. Prestwich & Burt, of Kingston-on-Thames, for wiring the new public schools for the electric light, at £165.

London.—The Highways Committee of the L.C.C. has received the following tenders for the execution of the roadwork and platelaying in connection with the reconstruction of the tramways in Holloway Road, Hackney Road, City Road, and Bow Road, the latter being for the overhead trolley system:—

Dick, Kerr & Co. ..	(recommended)	£93,116
John Mowlem & Co.		102,989
Robert W. Blackwell & Co.		104,314
W. Manders		106,093
J. G. White & Co.		108,324
Wm. Griffiths & Co.		114,506
British Electric Equipment Co. ..		120,000

The tender of Chas. Wall, amounting to £25,000, is also proposed to be accepted for the erection of a car-shed at Holloway; and that of Bolckow, Vaughan & Co. for the supply of bull-headed rails for the car-shed tracks for the sum of £1,513 10s. 6d. P. and W. MacLellan, Ltd., tendered at £1,609, the Barrow Hematite Steel Co. at £1,613 10s. 8d., and Cammell, Laird & Co. at £1,670 17s. 6d.

The undernoted tenders have also been received for the delivery of (1) track rails, and (2) slot rails and conductor tee rails, for further sections of the tramways:—

1.—Track Rails, &c.

E. Le Bas & Co.	(incomplete)	£27,240
The Lorain Steel Co., U.S.A.		28,026
Walter Scott, Ltd.		29,919
Bolckow, Vaughan & Co. ..	(recommended)	31,231
Barrow Hematite Steel Co.		31,965
P. & W. MacLellan		32,758
Steel, Peech & Tozer		35,675

Engineer's estimate, £25,907.

2.—Slot Rails and Conductor Tee Rails.

E. Le Bas & Co.		£20,877
P. & W. MacLellan		20,993
Frodingham Iron & Steel Co.	(recommended)	23,047
Bolckow, Vaughan & Co.		25,651
Walter Scott, Ltd.		26,087
Barrow Hematite Steel Co.		26,699

Engineer's estimate, £19,610.

The Highways Committee, in reporting on the offers, states that the lowest tender for track rails and those of the next two firms do not comply with the specification in regard to the time of delivery and in other respects. In the case of the slot rails, &c., neither of the two lowest tenders conforms with the specified time for delivery, and the Committee therefore recommends the acceptance of the third lowest tender, which is in accordance with the specification.

Radcliffe.—The U.D.C. has accepted the tender of Callender's Cable & Construction Co. for the supply of traction feeder cables.

Shanghai-Nanking Railway.—We understand that Messrs. D. Santoni & Co. (1906), Ltd., have just obtained in open competition the contract for the supply of 100 of their "Santoni" flame and enclosed arc lamps, with all poles and accessories, for £1,444.

Southampton Docks.—An order has been placed with Messrs. Johnson & Phillips, Ltd., for supplying and erecting cables and boxes for the coaling jetty.

Walsall.—The T.C. has accepted the following tenders for supplies to the tramways:—

Stewarts & Lloyds, Ltd.—Steam pipes.
British Thomson-Houston Co., Ltd.—Forged steel G.E. pinions.
Magnolia Anti-Friction Metal Co.—Bearing metal.
H. Peace & Co., Ltd.—Trolley wheels.
Docker Bros., Ltd.—Varnishes and gold size.
A. Hess & Bros., and T. H. Newsome & Co.—Oils.

West Ham.—The Corporation has placed an order with the General Electric Co. to convert a second of the existing 600-kw. Ferranti sets at the generating station to a two-phase set. The company are the contractors for the conversion of the first set, and they have agreed to carry out similar work to the second set for £827, being an increase of £22 upon their previous contract on account of the rise in the price of materials. The Council is to avail itself of the option, under its contract with Messrs. Willans & Robinson, Ltd., to order a second turbo-generator. The order is to be placed subject to the sanctioning of a loan for the estimated cost of £8,300. The electrical engineer reports that, so far as he can judge, it will not be necessary to install the second turbo-generator until September, 1908.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 25th).—At 5 p.m. Physical Society. Mr. W. A. Scoble on "The Strength and Behaviour of Brittle Materials under Combined Stress." Mr. F. Twyman on "A Spectrophotometer." Mr. K. J. Tarrant on "Photographs of Electric Sparks."
At 6.30 p.m. Northampton Institute. Annual prize distribution.
At 7 p.m. Armstrong College Engineering Society. Mr. J. C. Browne on "Electric Traction."
At 8 p.m. Institution of Civil Engineers (Students). Mr. C. A. Ablett on "Alternating-Current Commutator Meters."
At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting
At 7.30 p.m. The Chartered Institute of Secretaries. Mr. G. Moores on "Weights and Measures Reform."
At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Mr. E. G. L. Mosley on "Adaptability of Electricity to Mines."

Saturday, January 26th. Northampton Institute Engineering Society. Visit to the Gas Light and Coke Co.'s works, Beckton.
At 2.30 p.m. Institution of Electrical Engineers (London Students). Visit to one of the G.P.O. Telephone Exchanges.
At 6.30 p.m. Northampton Institute Annual Conversazione.
Tuesday, January 29th.—At 8 p.m. Faraday Society. General Discussion on "Osmotic Pressure."
Wednesday, January 30th.—At 7.30 p.m. Institution of Electrical Engineers (London Students). Mr. B. A. Tubini on "Telegraphy."
At 8 p.m. Institution of Civil Engineers. Students' visit to the Telegraph Department of the G.P.O.
At 8 p.m. Society of Arts. Mr. J. Parsons on "Apprenticeship."
Thursday, January 31st.—At 3 p.m. Royal Institution. Major P. A. MacMahon, D.Sc., on "Standards of Weights and Measures."
Friday, February 1st.—Northampton Institute Engineering Society. Mr. E. Graves on "A Few Points in Connection with A.C. Traction."
Saturday, February 2nd.—Institution of Electrical Engineers (Glasgow). Annual Smoking Concert.
At 2.30 p.m. Institution of Electrical Engineers (London Students). Visit to G.P.O. Telephone Exchange.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, January 28th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, January 29th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m. Medical examination recruits, 6.30 to 8 p.m.
Wednesday, January 30th.—"A" Badge examination.
Thursday, January 31st.—"C" Company, technical instruction, 7 p.m.
Friday, February 1st.—"D" Company, recruits' infantry drill, 6 p.m., technical instruction, 7 p.m.

Wilfrid C. Dumble, Captain, R.E., and Adjutant,
For O.C. E.E.R.E. (V.)

NOTES.

Parliamentary.—STANDING ORDER PROOFS.—On Friday the Examiners commenced the consideration of the Private Bills for next session, with regard to proofs of Standing Orders. The following were ordered to proceed: London County Council (Electric Supply), North-East London Railway, Sheffield Corporation, West Riding Tramways, Birmingham Corporation, Manchester Corporation Tramways, London Electric Supply, and the Barnsley, Wombwell and Meth Tramways.

The London County Council Tramways Bill and the Cavehill and Whitewell Tramways were postponed, the former till February 15th, and the latter till January 28th. Both these Bills are being opposed on Standing Orders.

On Monday the following Bills were ordered to proceed:—Oxford and District Tramways, Leicestershire and Warwickshire Electric Power, Newcastle-upon-Tyne Corporation, Electric Supply Corporation, Richmond (Surrey) Electricity Supply. The consideration of the Middlesbrough, Stockton-on-Tees and Thornaby Tramways was postponed till February 14th.

The Examiners on Tuesday considered a number of Bills, and among the Bills ordered to go forward were the London and North-Western Railway; Folkestone, Sandgate and Hythe Tramways; West Yorkshire Tramways; Great Northern and City Railway; Lower Thames Tunnel Tramways. Amongst the Bills which were postponed was that of the York and District Tramways until February 14th, as it is down in the list as opposed. In the case of the Boston Spa Gas, the promoters failed to comply with Standing Orders, and the matter will have to be reported to the House.

On Wednesday the Administrative County of London and District Electric Power, the London County Council (General Powers), the London United Tramways, the North Metropolitan Electric Supply, the Watford and Edgware Railway, and the London and District Electric Power Bills were ordered to go forward.

PRIVATE BILLS.—The Chairmen of Committees have met and decided that the following Bills shall originate in the House of Lords next session:—The Administrative County of London and District Electric Power, Birmingham Corporation, Cavehill and Whitewell Tramways, Electric Supply Corporation, Folkestone, Sandgate and Hythe Tramways, London and District Electric Power, London Electric Supply, Manchester Corporation Tramways, Middlesbrough, Stockton-on-Tees and Thornaby Tramways, West Riding Tramways, West Yorkshire Tramways and York and District Tramways.

SOMERSET AND DISTRICT ELECTRIC POWER BILL.—On Tuesday the promoters of this Bill should have appeared before the Examiners, to show proofs of compliance with Standing Orders; but as they did not appear, the Bill was marked "dead." The deposited measure had for its object the extension of time for commencing the works, to give powers for the purchase of loans, to enable the company to acquire provisional orders for the supply of electric light and also to issue capital at a discount.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (GLASGOW SECTION).—At a meeting of the Section on the 8th inst., Dr. J. T. Bottomley described a piece of apparatus invented by the Hon. R. J. Strutt, which showed in a remarkable way the properties of radium. A pair of gold leaves, after the manner of a gold-leaf electroscope, were hung from the bottom of a small tube containing a few grains of bromide of radium. The radium tube was supported from the top of the glass cover of the apparatus by a small bar of fused quartz which was a nearly perfect insulator. The radium itself was coated with a pasty solution of phosphoric acid, which made it conductive. As the very active beta emanation escaped through the walls of the radium tube, the alpha radiation electrified the gold leaves, which thereupon diverged. When they had diverged sufficiently they touched two aluminium plates and discharged themselves, the action going on periodically, and the leaves being charged and discharged. In the apparatus shown the leaves were charged and discharged in 3¼ minutes. The vessel which contained the apparatus was highly evacuated by means of a Sprengel pump, the air pressure being reduced to something like the ten-millionth of an atmosphere. Dr. Bottomley mentioned that he had set up the apparatus for the purpose of finding whether, after a very long time, the activity of radium decreased or disappeared. The observations will tell whether the period of action of a radium clock becomes longer with time.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER STUDENTS).—Mr. R. W. Willis, Hon. Secretary of the Students' Section, has resigned his position, having obtained an appointment with the Perth Corporation; Mr. L. H. A. Carr, of 60, Seymour Grove, Old Trafford, Manchester, has undertaken the duties.

The Annual Dinner of the Students' Section is to be held on February 9th.

INSTITUTION OF ELECTRICAL ENGINEERS (GLASGOW STUDENTS).—At a recent meeting, Prof. Magnus Maclean in the chair, Mr. R. Rankine, assistant in the department of Electrical Engineering in the Technical College, read a paper on the "Induction Motor."

ROYAL SOCIETY.—Among other papers set down to be read at last night's meeting we noted the following:—"Experiments on the Dark Space in Vacuum Tubes," by Sir Wm. Crookes; "On a New Iron Carbonyl, and on the Action of Light and of Heat on the Iron Carbonyls," by Sir James Dewar and Dr. H. O. Jones.

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS).—The meeting of the Students' Section, arranged for Wednesday, February 13th, has been postponed to Wednesday, February 20th.

GLASGOW TECHNICAL COLLEGE SCIENTIFIC SOCIETY.—A meeting of the Society was held on Saturday last, when Mr. W. W. Lackie presided. A paper on "The Development of the Alternating-Current Motor" was read by Mr. W. B. Hird.

On January 17th a lecture on "Smoke Prevention and Fuel Economy" was delivered by Mr. W. H. Booth to the ROYAL SCHOOL OF MILITARY ENGINEERING at Chatham. The lecturer took as the basis of his argument the fact that there were furnaces at work which produced perfect combustion with economy by adhering to the well-known principles which govern combustion. Practice had shown that with a sufficiently high temperature smokelessness was secured, and the problem practically resolved itself into a question of sufficiency of refractory lining. As regards economy of fuel, this was to be secured by regarding a furnace as a vessel in which fuel and air were combined in quantities as nearly as possible of the correct chemical equivalents in order that the percentage of carbon dioxide in the waste gases should be as great as possible. The lecture was illustrated by slides showing various forms of furnace for bituminous coal and for liquid fuel, steam-blown furnaces, induced draught fan installations and sundry boilers.

At a meeting of the CHARTERED INSTITUTE OF SECRETARIES held at Winchester House on Wednesday evening last, Mr. S. Jackson, of the Decimal Association, lectured on "The Metric System." To-night, before the same Institute, Mr. G. Moores is to lecture on "Weights and Measures Reform."

SOCIETY OF MOTOR-OMNIBUS ENGINEERS.—At a meeting of the above Society held last Monday, the 21st inst., at the Hotel Cecil, under the presidency of Mr. Shrapnell Smith, Editor of *The Commercial Motor*, a paper was read by Messrs. E. W. Hart and W. P. Durtnall upon "Petrol Electric Transmission for Road Vehicles in Comparison with Purely Mechanical Systems." An interesting discussion followed, which was adjourned until February 4th.

Mr. Charles Bright, F.R.S.E., M.I.E.E., lectured on the 17th inst. to the Royal Artillery Institution, Woolwich, on "Submarine Telegraphy."

The Lighting of Oxford Street.—Anyone who has of late seen Oxford Street by night cannot fail to admire the new method of lighting this important thoroughfare. We have not seen one better lighted. Below we are enabled to give a few particulars respecting the work, and are especially glad to note that so great an improvement can be maintained at a cost equal to the price paid previously for gas lighting. We hope we may not hear any more statements made about London going back to gas. To light the whole of the thoroughfare 81 flame arc lamps of the "Excello" type have been installed, these replacing 122 gas lamps. The lamps are arranged to burn nine in series on a 480-volt circuit and their current consumption amounts to 10 amperes, using 10 and 9 mm. carbons. The lamps burn for 16 hours. They are arranged, for the greater part, two on each pole, in the centre of the road, but there are six single centre pole and five single side pole lamps. Switches are placed at each end of each circuit of nine, and by means of a special plug, in the event of a fault occurring on any one circuit, half the lamps can be used on 240 volts. For the supply of energy 7/16 "Dialite" cables, supplied by the St. Helens Cable Co., were laid down in earthenware ducts. The lamps are placed at a height of 25 ft. from the roadway, on poles supplied by Messrs. Walter MacFarlane & Co. At 12.30 a.m. alternate lamps are switched off, one being left alight on each bracket. The inclusive charge per lamp per annum is £20 13s. 7d., which results in a total for the whole lighting exactly equal to that of the previous inferior gas lighting.

In spite, however, of the improvement made in the lighting, the "Roads Improvement Association" has found fault with the position of the poles in Oxford Street. It has communicated with the L.G.B. on the subject, alleging that the standards in the middle of the road are a source of danger to the public. It draws the attention of the Board to the fact that the practice was condemned by the Royal Commission on London Traffic, and that the St. Pancras B.C. has recently gone to considerable expense in removing electric lamp standards from the centre of the roadway between Portland Road Station and Tottenham Court Road. The Association did not, so far as we may judge from the reports published, mention when citing the above, that Oxford Street is considerably wider than the thoroughfare from which the St. Pancras B.C. has removed the centre poles. The Board replied that it is a matter in which it has no authority to intervene.

For Sale.—The Dewsbury Corporation is inviting tenders for the sale of 200 demand indicators. Some particulars appear among our advertisements.

The New Power Station of the G.E. Railway.—In their report for the past half-year, the Great Eastern Railway Co.'s directors state that the accounts show an expenditure of £53,445 for the electric power house at Stratford. The works are estimated to cost about £120,000, and will, when completed, supply the electricity for lighting the Liverpool Street Station and Hotel, as well as several of the suburban stations, the goods depôts, and the workshops at Stratford, and also the power for driving the machinery in the locomotive, carriage and wagon shops at Stratford.

The Rating of Tramroads.—Judgment was given in the Court of Appeal on Wednesday in the case of the Blackpool and Fleetwood Tramroad Co. *v.* the Thornton Urban District Council, in which the plaintiff company appealed from a decision of the Divisional Court of King's Bench. They had been rated as owners and occupiers of a tramway track on the full net annual value. They appealed to the Divisional Court on the ground that they had not been allowed the benefit of the reductions provided by the Public Health Act. The tramroad was constructed on lands which were the exclusive property of the company except where it passed over certain roads and public highways by means of level crossings. The respondents' case was that the land in question was not used as a railway and constructed under the powers of any Act of Parliament within the meaning of the Public Health Act. The company contended that it would, and could, only be worked as a railway, and was, in fact and in law, used as a railway, and the company was, therefore, entitled to assessment at one-fourth of the net annual value. Sir Gorell Barnes, in giving judgment, said it appeared to him that the line was only in fact constructed under the powers of the Act of Parliament for public conveyance, and therefore it appeared to him that the appellants had succeeded in showing that their lands were used only as a railway, and that the assessment ought to be reduced to one-fourth of the net annual value. Lords Justices Farwell and Buckley concurred, and the appeal was allowed, with costs.

Fatalities.—At an inquest held on 18th inst., at Longton, into the death of Herbert Griffiths, a Chester electrician, who succumbed to burns sustained whilst engaged in installing electric plant at the Park Hall Colliery in December last, lengthy expert evidence was given upon the relation of the motor to the explosion. The Coroner pointed out that the experts differed in their opinions, and he advised the jury to find that deceased succumbed to burns sustained through an explosion, but that there was not sufficient evidence to show how the explosion was caused.

A correspondent writes that on Monday a youth, named Oswald Walker (17), was found unconscious, sitting near an electrical motor at Messrs. Hartley Bros.' Works, Ravensthorpe, Yorks, curriers. He was badly burnt about the hands, and he died immediately from injuries.

New Map of the Metropolis.—Mr. Edward Stanford, of 13 and 14, Long Acre, W.C., has just published a new map (selling in sheet form at 1s., and at 3s. 6d. folded in case), which shows the various Metropolitan railways, tramways and miscellaneous improvements as deposited at the London County Council by November 30th, 1906, for the 1907 session. Among other things indicated on the map is the important proposed electric line of the London and North-Western Railway, the railways and tramways in operation, railways sanctioned or proposed, the boundary of the Administrative County of London, the proposed areas under the L.C.C. Electric Supply Bill, and the London and District Electric Power scheme, &c. The map is of handy size (roughly 20 in. × 15 in.), and is one to which electrical men will have occasion to refer pretty frequently during, at any rate, the next six months as the various new schemes affecting London electric supply and transportation matters come under Parliamentary consideration.

The Brush Strike.—The *Nottingham Guardian* says that the dispute at the Brush Electrical Engineering Co.'s Works, which commenced 17 or 18 weeks ago, is not yet settled. On January 17th a conference arranged by the Board of Trade was held between Lord Vaux, the chairman of the company, and Mr. J. J. Steinitz, and representatives of the men, but it is stated that the company refused to give way at all in regard to the rate. As we recently pointed out in our pages, the company seems to be fully served by the new men taken on in the place of the strikers.

Motor-Car Progress.—Under this heading the *Morning Post* specialist ended the old year with the following description of a momentous discovery:—"In connection with obtaining the maximum efficiency from a motor, an ingenious device by way of an indicator has been shown in use on a Saurer motor. Owing to the amazing rapidity with which an internal combustion motor turns, the indication is by means of a series of light flashes from a needle point, as it were. By this means you can readily detect precisely at what position of each revolution of the crankshaft there is undue efficiency, though in place of being a wavy line, as it were, the curve is in shape somewhat like the outline of a boot, the heel to the tag part representing the increase of pressure arising from the explosion or power-stroke; from there to the toe the exhaust and intake, and along the sole the compression stroke, as it were. By seeing over which of these areas there is less than normal indication, it is practically possible to detect the cause of inefficiency without examining the motor." After that, who is bold enough to assert that our Board Schools are useless? The paragraph simply reeks with discoveries, and luckily for the world it was signed.

Tramcar Brakes.—The Highways Committee at Tuesday's meeting of the L.C.C. referred to the report by Lieut.-Col. H. A. Yorke on the tramway accident in Archway Road last June, to the Inspector's recognition of the series of tests carried out by the County Council's chief officer of tramways, and to his approval of the suggestion that a supplemental mechanical device should be fitted in connection with the magnetic brake, so that the latter might be applied by hand, if necessary. A large number of the Council's cars had been fitted with a special type of electro-magnetic brake. One of the difficulties referred to by the Board of Trade Inspector in the Highgate accident was that the power for working the electro-magnetic brake on the car was derived from a motor which was worked by the revolution of the wheels, and when these skidded the appliance became useless. If, however, the brake were properly applied it was adequate for stopping the car, and, as a rule, such accidents arose from defective judgment on the part of the motormen. The supplementary apparatus above-mentioned was intended to obviate that difficulty, and had been designed as an additional safeguard by the chief officer, and developed at the car works at New Cross. The apparatus had been fitted and tested on two of the cars, and it appeared likely to meet, in a great degree, the special object for which it was designed. The Committee proceeded to state that the sanction of the Board of Trade was necessary to the increase in the speed of the cars, and a higher speed had been allowed on new routes in respect of all cars fitted with magnetic track brakes. It was hoped that the increase would be extended to the cars on the other lines, and that would mean a large advance in the earning power of the tramways.

Appointment Vacant.—Instructor in Mathematics, for the Northampton Institute (£120 per session).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—Mr. A. P. MACALISTER, chief assistant and deputy borough electrical engineer at Battersea, was appointed by a very large majority on Friday last to a similar position under the Islington Borough Council.

The second annual dinner of the Harrow Electric Light Co. was held in the engineers' rooms at the works on Tuesday last week, Mr. Spencer Hawes presiding. After the toasts, "The Company and the Directors" and "The Staff," had been proposed and responded to, a presentation of a clock was made to Mr. WALTER BARNES, the retiring secretary, who had been with the company for five years. Mr. Barnes is followed by Mr. Bishop.

Mr. WALTER HUNT, having resigned his position on the Metropolitan Railway's sub-station staff, sailed on 19th inst. to West Africa to take up position of electrician on the Wassau (Gold Coast) mine at Adjah Bippo.

The Leek U.D.C. has appointed Mr. A. HEMMINGS, of Horsham, Sussex, as junior assistant engineer at the electricity works.

Out of 160 applicants, Mr. ARTHUR C. JOHNSON has been appointed assistant electrical engineer at Southend-on-Sea. Mr. Johnson was formerly at the Southend Electricity Works. The T.C. has appointed Mr. H. COLLINS as switchboard attendant, and Mr. A. S. HOOPEL, senior switchboard attendant, as junior assistant engineer.

Mr. W. H. CLEGG, who has been representing the National Electric Construction Co. as engineer for Ireland for the last six years, has been appointed resident engineer at the Council's electricity works at Bo'ness, N.B.

COTTAM-STOWER.—On Wednesday last Mr. GEO. H. COTTAM, M.I.E.E., chief electrical engineer to the Borough of Hampstead, was married to Mrs. L. McGregor Stower, at St. Peter's Church, Belsize Square. A large gathering of their friends attended to witness the ceremony, and were subsequently received by the bride and bridegroom at the Town Hall. On the previous day Mr. Cottam was presented with a handsome silver tray by the staff and workmen of the department. We offer the newly-married pair our sincere congratulations and best wishes.

Mr. ROBERT W. WILLIS has resigned his position at the Salford generating station, and has taken up the office of mains superintendent to the Perth Corporation. He has consequently relinquished the post of secretary of the Manchester I.E.E. Students' Section.

Tramway Officials.—Mr. R. WITHYCOMBE, general engineering assistant to the West Ham tramway undertaking, has resigned his position.

Mr. P. HUMPHRIES, A.M.I.E.E., the engineer and manager of the Isle of Thanet Electric Tramways and Lighting Co., Ltd., has resigned his position and is going out shortly to take control of the Malta tramways.

General.—Mr. PHILIP DAWE, consulting engineer, announces that his address is now Dacre House, Victoria Street, Westminster, S.W.

We are informed that Mr. CHAS. L. HARBERT resigned his post as manager of the Order and Forwarding Departments of the British Prometheus Co., Ltd., on the 19th inst., to take up a more lucrative position.

NEW COMPANIES REGISTERED.

H. W. Kearns & Co., Ltd. (91,631).—This company was registered on January 12th, with a capital of £50,000 in £1 shares, to carry on the business of machine tool makers, machinists, ironmasters, wire drawers, galvanisers, iron and brassfounders, iron and steel converters, metal workers, colliery and quarryowners, miners, smelters, boiler and tube makers, electric, hydraulic, fire, gas and general engineers, electric cable manufacturers, coppersmiths, electricians, suppliers of electricity for light, heat, motive power or other purposes, builders of tramcars, wagons, electric cars, locomotives, motor-cars, rolling stock, cranes, sluices and other appliances and machinery, &c. The first subscribers (each with one share) are:—H. W. Kearns, Baxenden House, Accrington, engineer; W. E. Kearns, Cowpe, Waterfoot, bleacher, &c.; J. S. Kearns, Cowpe, Waterfoot, bleacher, &c.; T. B. Burton, 1, Harriet Street, Edge Lane, Stretford, near Manchester, engineer; J. R. C. Kearns, Baxenden House, Accrington, engineer; J. P. T. Slade, Wellacre, The Mount, Altrincham, engineer; and E. Hoyle, Spring Mount, Bacup, cotton spinner. No initial public issue; the number of directors is not to be less than three or more than five; the first are H. W. Kearns (chairman), J. S. Kearns, J. R. C. Kearns, T. B. Burton and J. P. T. Slade; the last three named are managing directors; qualification, £500; remuneration of managing directors as fixed by the board; of others as fixed by the company.

Lumb Electrical Bleaching Co., Ltd. (91,562).—This company was registered on January 7th, with a capital of £15,000 in £1 shares, to adopt an agreement with C. Martin, for the acquisition of the assets of the Electrical Bleaching Co. (1904), Ltd., and to carry on the business of bleachers, dyers, dressers, finishers, makers of bleaching materials, &c. The first subscribers (each with one share) are:—A. Morum, St. Michael's House, Basinghall Street, E.C., merchant; H. Pratt, St. Michael's House, Basinghall Street, E.C., agent; W. Carsley, St. Michael's House, Basinghall Street, E.C., merchant; E. L. Thorp, Bank House, Edenfield, near Manchester, electrical engineer; H. Gorst, 57, Burnley Road, Edenfield, near Manchester, bleachers' foreman; J. Hill, Lumb House, Edenfield, near Manchester, bleachworks' manager; and J. Hill, jun., Lumb House, Edenfield, near Manchester, finisher. Minimum cash subscription 1,000 shares. The number of directors is not to be less than two or more than five; the first are A. Morum and C. Martin; qualification, £200; remuneration, 1 guinea each per meeting attended. Registered office, Lumb Mills, Edenfield, near Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Installations, Ltd. (London) (91,050).—Particulars of £2,000 debentures, created December 5th, 1906, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on December 8th of £1,100 5 per cent. debentures, part of series created July 14th, 1906, to secure £35,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £33,700.

Electric Reduction Co., Ltd. (54,724).—This company's annual return was filed on November 10th, when the entire capital of £40,000 in 16,200 preference and 23,800 ordinary shares of £1 each had been taken up. £1 per share has been called up on 13,000 preference, resulting in the receipt of £13,000. £27,000 is considered as paid on 3,200 preference and 23,800 ordinary. Mortgages and charges: £7,500.

Himalaya Electric Railway, Ltd. (59,538).—This company's annual return was filed on December 8th, when the entire capital of £3,000 in £1 shares had been taken up and was considered as fully paid. Mortgages and charges: Nil.

Houghton-le-Springs and District Electric Lighting Co., Ltd. (83,784).—This company's annual return, made up to May 30th, 1905, was filed on October 20th, 1906. The entire capital of £15,000 in £1 shares has been taken up. £1 per share has been called up on 7 and 1s. per share on 14,993 shares, resulting in the receipt of £752 13s. £4 remains in arrears. Mortgages and charges: Nil.

Wrexham and District Electric Tramways, Ltd. (71,213).—A 4½ per cent. debenture, dated December 14th, 1906, to secure £4,500, charged on the company's property, present and future, has been registered. Holders: British Electric Traction Co., Ltd., Donington House, Norfolk Street, W.C.

Cambridge Electric Supply Co., Ltd. (36,457).—A second debenture dated December 12th, 1906, to secure an unspecified amount, but stamped to cover £10,000, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: Capital and Counties Bank, Ltd., 39, Threadneedle Street, E.C.; trustees for bank, E. D. Vaisey, 39, Threadneedle Street, E.C.; and H. S. Simpson, 3, Sidney Street, Cambridge.

Windham's, Ltd. (formerly "Patent Night Signs Co., Ltd.") (71,897).—Issue on December 10th of a £100 8 per cent. debenture, part of series created December 5th, 1906, to secure £200, charged on the company's property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Geo. Bray & Co., Ltd. (Electrical and gas engineers, Leeds) (76,185).—A deed appointing new trustee, dated December 11th, 1906 (supplemental to a trust deed dated August 27th, 1906, securing £40,000 debenture stock), has been registered. The deed confirms the assignment to the trustees of certain inventions and patents, and interests therein, and the company's interest in a declaration of trust. Present trustees: J. W. Close, East Parade, Leeds; and J. W. Bray, Belmont, Headingley, Leeds.

Topsham Electricity Supply Co., Ltd. (80,826).—An amended return has been filed *re* £200 debentures created October 22nd, and issued December 6th, 1906. In the original return the rate of interest on the whole amount was given as 4 per cent. It is now stated as 4 per cent. on one debenture of £100, and 5 per cent. on the other debenture of £100.

Sunderland District Electric Tramways, Ltd. (79,054).—A deed of charge dated December 14th, 1906, to secure not more than £20,000, has been registered. Property charged: The company's undertaking and property, present and future, subject to trust deed of December 8th, 1903. Holders: H. R. Hogg, 13, St. Helen's Place, E.C.,; and C. P. Crisp, 11, Angel Court, E.C.

Lyndhurst Electric Lighting and Traction Co., Ltd. (67,264).—This company's annual return was filed on November 26th, when 1,750 shares had been taken up and paid for in full out of a nominal capital of £6,000 in £1 shares. Mortgages and charges: Nil. (Name changed to "Lyndhurst, Ltd." on December 8th.)

Accessories Manufacturing Co., Ltd. (Electricians, London) (84,107).—Issue on December 18th of £800 5 per cent. second debentures, part of series created November 28th, 1906, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Cowper-Coles Copper Corporation, Ltd. (89,493).—£5,000 10 per cent. debentures, created August 10th and dated November 6th, 1906, charged on the company's undertaking and property, present and future, except uncalled capital, have been registered. No trustees.

British Prometheus Co., Ltd. (74,889).—A memorandum of satisfaction in full of a debenture dated September 12th, 1905, securing £500, has been filed.

Engineering Instruments, Ltd. (London) (66,427).—Issue on December 20th of £2,110 5 per cent. debentures, part of series created November 30th, 1906, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Bogota Telephone Co., Ltd. (69,059).—A trust deed dated December 12th, 1906, to secure £25,000 second mortgage debentures, has been registered. Property charged: Lands, buildings, concessions and grants at Bogota, Colombia, and the company's undertaking and property, present and future, including uncalled capital, subject to £15,000 first mortgage debentures. Trustee: S. H. Jenks, Barrow Hedges, Carshalton.

Urban Electric Supply Co., Ltd. (57,986).—A deed dated December 17th, 1906 (supplemental to a trust deed dated July 28th, 1904, securing £200,000 first mortgage debenture stock, with power to issue further stock ranking *pari passu* upon the terms mentioned in the said trust deed), has been registered. Property charged: Electric lighting and tramway undertakings, lands, buildings, materials and plant, freehold and leasehold hereditaments, shares, purchase moneys and other specific assets, and the company's undertaking and general property, present and future, including uncalled capital. Trustees, Merchants' Trust, Ltd., 63, Cornhill, E.C.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on January 1st of £2,000 6 per cent. second debentures, part of series created July 10th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £11,000.

Keighley Electrical Engineering Co., Ltd. (44,893).—This company's annual return, made up to October 1st, was filed on December 31st. 4,100 ordinary and 1,000 preference shares had been taken up out of a nominal capital of £10,000 in 8,000 ordinary and 2,000 preference shares of £1 each. £1 per share has been called up on 2,488 ordinary and 1,000 preference, resulting in the receipt of £3,488. 1,612 shares are considered as fully paid. Mortgages and charges: £3,000.

Blackpool and Garstang Electric Light Railway Co., Ltd. (62,150).—This company's annual return was filed on December 21st, when 361 shares had been taken up out of a nominal capital of £10,000 in £5 shares. £4 per share has been called up, resulting in the receipt of £1,707 (? including payments in advance). £60 remains in arrears. Mortgages and charges: Nil.

C. and A. Musker (1901), Ltd. (Electrical and Hydraulic Engineers, Liverpool) (70,573).—An assignment of patents, dated December 20th, 1906, (supplemental to a trust deed dated July 8th, 1901, securing £50,000 debenture stock) has been registered. Property charged: Patents Nos. 18,617 and 18,884 of 1902, and 18,318 of 1904. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C.

Buenos Ayres Port and City Tramways, Ltd. (85,427).—This company's annual return, made up to December 29th, has been filed. 28,807 shares have been taken up out of a nominal capital of £200,000 in 40,000 shares of £5 each. 10s. per share has been called up on 407, resulting in the receipt of £203 10s. £142,000 is considered as paid on 28,400. Mortgages and charges: £200,000.

Ernest Scott & Mountain, Ltd. (Electrical Engineers, Newcastle-on-Tyne.) (32,760).—Particulars of £25,000 5 per cent. debentures created by board resolution of December 18th, 1906, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Bastian & Partners, Ltd. (Electricity Meter Manufacturers, London.) (77,601).—Issue on January 9th of £550 10 per cent. debentures, part of series created July 1st, 1905, to secure £4,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series, £2,775.

ELECTRIC TRAMWAY ACCOUNTS.

Salford Municipal Tramways.

THE accounts for the year ended March 31st last show that another substantial donation from the tramways undertaking was placed to the credit of the borough fund. The revenue per mile of route shows an increase over that of the previous year, but the income per car-mile shows a slight falling off. The total expenses per car-mile increased to a slight extent also. After meeting all expenses, financial and otherwise, the surplus amounted to, approximately, ·88d. per car-mile.

Four new routes were opened during the year. Under an agreement with the Manchester Corporation and the Trafford Park Estates Co., the Salford Corporation is now jointly with the Manchester Corporation working a through service of cars from the City into the Park, which service should be appreciated by the large number of employés of the works on the estate. In order to enable the Salford cars to enter the Park, it was necessary to lay down additional track on the Trafford Road swing bridge, and to erect special overhead work and track connections at the point where the roadway and bridge divide, during the swinging of the latter. The work was undertaken by the Manchester Corporation.

GENERAL STATEMENT.

For 12 months ending March 31st	1906.	1905.
Length of route	41·12 miles.	38·75 miles.
Total length of track	74·75 „	70·75 „
Average number of cars in use ...	122	117
Car-miles run	5,257,223	4,884,590
Passengers carried per annum... ...	41,807,539	39,213,560
Capital expended to date	£657,564	£638,332
Traffic receipts	£223,033	£209,656
Total receipts	£226,013	£209,672
Working expenses	£144,194	£134,892
Gross profit	£81,819	£74,780
Income per car-mile	10·18d.	10·3d.
Working expenses per car-mile ...	6·58d.	6·62d.
Interest and sinking fund per car-mile	1·83d.	1·87d.
Rental of leased lines	·89d.	·79d.
Total expenses per car-mile	9·3d.	9·28d.
Profit or loss per car-mile	+ ·88d.	+ 1·02d.
Cost of energy per car-mile	2·21d.	2·10d.
Average fare per passenger	1·28d.	1·28d.
Average fare charged per mile ...	·59d.	·59d.
Revenue per mile of route	£5,400	£5,376
Expenditure per mile of route ...	£3,500	£3,458
Total units used	7,784,292	6,927,805
Units used per car-mile	1·48	1·41
Percentage of working ex'es to receipts	64·6%	64%

PROFIT STATEMENT, 1906.

Interest on sinking fund charges	£39,959
Rental (leased lines, running powers, &c.) ...	19,558
Contribution in relief of rates	13,000
Depreciation and renewals fund	9,302
Gross profit and accumulated interest ...	£81,819

The gross profit on the year's working amounted to £79,713, interest on investments, &c., bringing the total balance available up to £81,819. The amount standing, at March last, to the credit of the depreciation and renewals fund was £30,439.

Mr. G. W. Holford is the general manager.

ELECTRICITY SUPPLY ACCOUNTS.

Melbourne Municipal Electricity Supply.

THE year 1905-6 proved a very satisfactory one, as far as this undertaking is concerned. The net profit for the year amounted to £13,870, and from this sum a special contribution of £5,000 was placed towards wiping out the cost of changing over installations which took place within recent date. A further sum of £7,509 was allocated to depreciation, making a total sum of £15,007 credited to this account in 1906. The sum of £3,753 allocated to sinking fund account is based on 1 per cent. only on the capital debt to date. The contribution of £1,000 to the Town Fund is the first made by the undertaking. During the year £1,183 was spent on building extensions, £9,490 on machinery, £5,044 on mains, &c., and £1,617 on meters. The total revenue increased by £2,629, £1,555 of this increase being from the sale of energy for power and heating purposes. This increase, however, does not indicate the increased output, owing to a substantial reduction in prices charged during the year under review, as compared with 1904-5; as a matter of fact, the output increased by 477,887 units. Working expenses were reduced by £1,114, this being attributed to the introduction of mechanical stokers, by means of which slack coal could be used.

During 1905-6 the demand for energy for power increased by 39·5 per cent. over that of the previous year, the number of units sold for this purpose being 867,459.

The work of erecting flame arcs in the central portion of the city was carried out during last year; the contract comprised 140 lamps, and a number of steel poles, brackets, &c. The extension of the city by the inclusion of North Melbourne, will probably necessitate substantial additions to the station and mains within the two years as from February, 1906.

The prices charged are:—Private lighting, 5d., 4½d., or 7d. and 2d. per unit; power, 2d. per unit; public lamps, £5 to £25 per annum, each. The chief engineer is Mr. H. R. Harper.

GENERAL STATEMENT FOR YEAR ENDING FEBRUARY 28TH, 1906.

Total capital expended	£380,565
Number of units sold—	
Private supply, including municipal bldgs.	3,213,682
Public lighting	1,245,903
Total number of units sold	4,459,585
Equivalent No. 16-C.P. lamps connected ...	88,982
H.P. of motor connected	653 = 1,666 H.P.
Number of public lamps	804 arcs, 3,117 inc.
Maximum load in KW.	1,886 KW.
Revenue account—	
Gross revenue	£72,214
„ expenditure	£33,628
„ profit...	£38,586
Average inclusive price obtained per unit—	
Private supply	3·64d.
Public lighting	3·84d.
Total, including municipal buildings ...	3·85d.

REVENUE ACCOUNT FOR YEAR ENDING FEBRUARY 28TH, 1906.

Gross revenue	£72,214	= 3·85d. per unit.
Works and distribution costs (including public lighting) ...	£29,437	= 1·58d. „
Total working costs	£33,628	= 1·81d. „

PROFIT STATEMENT, 1906.

Interest on loans	£13,456
Sinking fund...	3,753
Depreciation...	15,007
To cost of change-over	5,000
To Town Fund	1,000
Sundries	502
Balance brought forward	132
Gross profit	£38,586

CITY NOTES.

Metropolitan Railway Co.

THE directors reported at the meeting held yesterday that the total receipts for the half-year ending December 31st, 1906 (deducting this company's proportion of the revenue of the City lines and extensions) have been £343,876, and the expenses £197,874, leaving a profit of £146,002. The receipts show a decrease of £100,468, and the expenses a decrease of £17,078, as compared with the corresponding half-year of 1905. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges and the dividend upon the preference stocks, shows a balance of £20,152 available for dividend upon the ordinary stock. The directors accordingly recommend the proprietors to declare a dividend upon the ordinary stock for the past half-year, at the rate of 10s. per cent. per annum, and to carry forward the balance of £5,822 to the next half-year's accounts. The accounts compare with a period prior to the opening of the new Great Central and Great Western joint line and the consequent diversion of part of the Great Central Co.'s traffic from the Metropolitan system, and the falling off in revenue is due partly to this cause and partly to the increased competition of the motor-omnibuses. The Surplus Lands Committee announces, as shown in the report and accounts appended thereto, that the dividend on the surplus lands stock, for the past half-year, will be at the rate of £2 15s. per cent. per annum.

Electrification of Line.—Considerable progress has been made during the half-year with the scheme of electrification undertaken some time ago, and it is now practically completed. All the trains passing through the tunnel section of the line north of Baker Street are worked by electricity. The Hammersmith and City and Addison Road services are now worked by electric trains, and the whole of the passenger trains on the Inner Circle are worked by that power, with the exception of a few between Praed Street Junction and Aldgate belonging to the Great Western Co, which will be worked by electricity in the course of a short time.

Automatic Signalling.—Experiments are being made with a system of automatic signalling, which, if successful, will admit of more trains being worked over the Inner Circle than has been possible under the old arrangements and so will increase the earning power of the line.

Motor-Omnibus Competition.—The competition of the motor-omnibuses continues to make an appreciable difference in the company's traffic, particularly on the St. John's Wood line. These motor-omnibuses are in effect subsidised by the local authorities, inasmuch as they pay nothing for the use of the roads or in respect of rates except in so far as their stables are concerned.

Improvements at Baker Street.—Plans have been prepared and arrangements made for extensive alterations at Baker Street Station, including the connecting up of the St. John's Wood line with the Inner Circle, in order to admit of a through service of trains being worked between the stations north of Baker Street and the City.

Maintenance of Electrical Plant and Rolling Stock.—It is proposed to devote an amount of £22,000 received from the contractors for the power station at Neasden, in settlement of a claim made upon them by the company, to the formation of a depreciation and renewal fund for the electrical plant and the new rolling stock.

Bills in Parliament.—A Bill is being introduced into Parliament in the next Session to enable the company to establish a pension fund for their outdoor staff. No further capital powers are being sought. Other Bills affecting the interests of the company have been deposited and will be carefully watched by the board.

Progress of Traffic.—The progress of the traffic of the railway is shown in the following table:—

Year.	Number of passengers.	Gross receipts for passengers, goods, minerals, and tolls.
p 1899	96,050,502 ...	... £817,338
q 1900	93,333,025 ...	... 823,304
1901	87,821,904 ...	... 775,450
1902	89,874,833 ...	... 792,041
1903	94,000,150 ...	... 812,685
r 1904	94,436,498 ...	... 831,221
1905	95,694,616 ...	... 832,034
s 1906	98,384,766 ...	... 681,268

(*p*) Great Central Railway extension to London opened March 15th, 1899.
(*q*) Central London Railway opened July 30th, 1900.
(*r*) Harrow and Uxbridge Railway opened July 4th, 1904.
(*s*) Line from Harrow to Verney Junction leased to Metropolitan and Great Central Joint Committee April 2nd, 1906.

There are 77 miles 34 chains constructed, and an additional 13 miles 48 chains of foreign lines are worked. The statement of train mileage is as follows:—

Half-year ended Dec. 31st, 1905.	Trains.	Miles this half-year.
782,223	Steam passenger trains ...	523,583
549,607	Electric passenger trains	825,897
96,517	Goods and mineral trains	96,758
1,428,347	Total...	1,446,238

City and South London Railway Co.

The report of the directors for the half-year ending December 31st, 1906, which is to come before the half-yearly meeting on Tuesday next, states that the receipts from all sources for the past half-year have amounted to £77,122, and the cost of working has been £35,736, leaving a profit of £41,386. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £46,331. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £33,571. The directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896 and 1901, and that a dividend at the rate of 2 per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £2,521 to be carried forward. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway, and dividends paid in each half-year:—

June 30th, 1904 ...	9,226,987	£76,388	2½ %
December 31st, 1904 ...	8,401,846	£70,706	1¾ %
June 30th, 1905 ...	8,662,588	£71,802	2 %
December 31st, 1905 ...	8,607,486	£70,104	1¾ %
June 30th, 1906 ...	9,045,120	£72,454	2½ %
December 31st, 1096 ...	9,104,293	£72,228	2 %

Baker Street and Waterloo Railway opened Westminster Bridge Road March 10th, 1906, and to Elephant and Castle August 5th, 1906.
Great Northern, Piccadilly and Brompton Railway opened December 15th, 1906.
Electric trams over Westminster Bridge to John Carpenter Street December 15th, 1906.

The dividend on the ordinary stock at the rate of 2 per cent. per annum compares with 1¾ for the corresponding period last year. The average dividend for 1906 is thus £2 2s. 6d. per cent.

In regard to the Euston extension, the progress made by the contractors has been very satisfactory, and the electric equipment, the lifts and the new rolling stock are also well advanced, and it is anticipated that the extension to Euston will be opened for traffic some time in March. The engineers report that the important work at Stockwell sidings is nearly completed. These sidings will afford additional facilities for dealing with the increased traffic resulting from the opening of the extension. The subway communication at the Elephant and Castle Station of this company with that of the Baker Street and Waterloo Co. was opened on August 10th last. The advantages of this connection have been increasingly appreciated by the travelling public.

Negotiations are in progress for through bookings between this company's line and the suburban stations of the London and North-Western Railway, Midland Railway and the Great Northern Railway, also with the Great Northern, Piccadilly and Brompton and the Charing Cross, Euston and Hampstead Railways. The board, after mature consideration, decided on making a public issue of £150,000 5 per cent. preference stock, 1903, offering the stockholders in the company a preferential allotment. The stock was well over-subscribed, and one-third was applied for and allotted to existing stockholders. The issue of further capital to meet the requirements for completing and equipping the Euston extension and the sidings at Stockwell is receiving consideration. The train mileage during the half-year was 552,048, against 546,992 in the corresponding half of 1905.

Messrs. Baker, Mott & Hay, the engineers, in their report on the progress of the Euston extension, state that the whole of the tunnelling is complete, the permanent way is laid, and the surface stations, including lifts and staircases are rapidly approaching completion. They anticipate that the whole of the works will be completed and the line ready for opening about the middle of March.

Direct United States Cable Co., Ltd.

The directors' report, which is to be presented at the meeting next Tuesday, says that for the half-year ended December 31st, 1906, the revenue, after deducting out-payments, amounted to £60,380 as compared with £56,353 for the corresponding period of 1905, showing a difference of £4,027 in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of cable maintenance, amounted to £25,381, leaving a balance of £34,999 as the net profit, making with £6,317 brought forward from the previous half-year a total of £41,316. For the corresponding period of 1905, the working and other payments amounted to £23,299. Interim dividends of 4s. per share for the quarter ended September 30th, 1906 (paid October 26th, 1906), and of 4s. per share for the quarter ended December 31st, 1906, payable January 31st, 1907, together amounting to £24,284, have been declared, and the balance of £17,032 on the revenue account has been carried forward. The reserve fund account has been debited with £2,805 for the cost of cable maintenance, and after being credited with interest on the investments and profit on sale of securities, the balance now amounts to £509,995.

Eastern Telegraph Co., Ltd.

The directors' report for the half-year ended September 30th, 1906, presented at the meeting held on Wednesday, states that the revenue for the period amounted to £557,515, from which are deducted £195,605 for the ordinary expenses, and £57,628 for expenditure relating to maintenance of cables, depreciation of spare cable, sundry differences in exchange, and income-tax payable abroad, leaving a balance of £304,282, to which is added £2,267 brought from the preceding half-year, making a total available balance of £306,549. After providing for income-tax payable in England, interest on mortgage debenture stock, and for two quarterly dividends on the preference stock, which in all absorb £82,459, there remains a balance of £224,090, out of which the directors have placed £7,000 to the reserve fund for maintenance ships, and have allocated £100,000 to meet the two interim dividends of 1¼ per cent. each on the ordinary stock, the balance of £117,090 being carried forward. With the object of facilitating the settlement of accounts under the numerous traffic arrangements which exist with the various Government administrations and telegraph companies, the directors have decided in future to make up the accounts of the company to June 30th and December 31st of each year, instead of September 30th and March 31st as formerly. Consequently a balance-sheet will be prepared as at December 31st, 1906, which will be submitted to the stockholders at a general meeting to be held in May next, when the final dividend and bonus, hitherto paid in July, will be proposed and paid.

Prospectuses.—*Imperial Ethiopian Rubber Co., Ltd.*—This company has been to the public with an issue of 100,000 shares of £1 each. The company has a 25 years' concession for rubber collection in, and exportation from, the Empire of Ethiopia (Abyssinia).

Anglo-Spanish Copper Co., Ltd.—This company, which acquires a lease in perpetuity of copper and sulphur mines in Huelva, Spain, has been before the public with an issue of 125,000 £1 shares.

New Einasleigh Copper Mines, Ltd.—This company also has been making a public issue of 76,000 £1 shares and £32,000 6 per cent. debentures. The mines being acquired are situated in North Queensland.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be quoted in the Official List:—

United River Plate Telephone Co., Ltd.—Further issue of 20,000 ordinary shares of £5 each, fully paid, Nos. 80,001 to 100,000.

Official Announcements re Companies. — It is notified in the *London Gazette* that the following companies will be struck off the register in three months, unless cause is shown to the contrary:—

Electric Battery Case and Fittings Syndicate.
Electric Danite Syndicate.
Electric Lamp Renovating Co.
Electric Vehicle Co. of Great Britain.
Freshwater and Totland (I.W.) Electricity Supply Co.
Monte Video New Tramway Co.
Torquay Electro-Therapeutic Institute.
Tramway Traction Co. of South America.

Montreal Light, Heat and Power Co.—Dividend for the past three months at the rate of 5 per cent. per annum.

Waterloo and City Railway Co.—The half-yearly meeting is to be held on February 7th.

British Continental Electricity Co., Ltd.—We understand that this company has posted dividend warrants to the value of £2,087 11s. 11d., in payment of the whole of the arrears of dividend on the 5½ per cent. cumulative preference shares, and also that a new issue of £1,000 in ordinary shares has been made and fully subscribed.

MARKET QUOTATIONS.

Wednesday, January 23rd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10¾d.	..
a ,, (50 %)	per gal.	1/-	..
a Copper Sulphate	per ton	£32 10	..
a Lead, Nitrate	per ton	£34 10	..
a ,, White Sugar	per ton	£35	..
a ,, Peroxide	per ton	£39	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160°C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b ,, Wire, in ton lots	per ton	£220	..
b ,, Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£61 to £203	..
c Brass (rolled metal 2" to 12") basis	per lb.	11¼d.	..
c ,, Tube (brazed)	per lb.	1/0½	..
c ,, ,, (solid drawn)	per lb.	11¼d.	..
c ,, Wire, basis	per lb.	11d.	..
c Copper Tubes (brazed)	per lb.	1/2½	..
c ,, ,, (solid drawn)	per lb.	1/2½	..
g Copper Bars (best selected)	per ton	£124	..
g Copper Sheet	per ton	£124	..
g ,, Rod	per ton	£124	..
e ,, (Electrolytic) Bars	per ton	£115	..
e ,, ,, Sheets	per ton	£127	..
e ,, ,, Rod	per ton	£117	..
e ,, ,, H.C. Wire	per lb.	1/1½	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/9	1d. inc.
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/0½ to 5/2½	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	59/7½	dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£20 2 6 to £20 5	2/6 inc.
g ,, ,, Sheet	per ton	£21 12 6 to £21 15	2/6 inc.
m Manganin Wire No. 28	per lb.	8/	..
g Mercury	per bot.	£7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p ,, rolled bars & rods	per lb.	1/5½ to 1/6½	..
p ,, ,, strip & sheet	per lb.	1/6 to 1/10	..
o Platinum	per oz.	150/-	..
e Silicium Bronze Wire	per lb.	1/3	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£192 10 to £193 10	£3 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals— "White Ant" brand	per ton	£61 to £88	..
k Zinc, Sh't's (Vieille Montagne bnd.)	per ton	£31 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

STOCKS AND SHARES.

Tuesday Afternoon.

So far as any return of business is concerned, the Bank Rate might just as well have remained at 6 per cent., the reduction not having assisted more than one or two markets, and those devoted to the highest class stocks. For this apparent paradox the financial situation in New York is principally to blame. Rumours of trouble loomed largely in connection with Americans, and there can be no doubt that if even a semi-panic were to occur in Wall Street, the consequences on this side might prove disastrous for the time being.

The dividends declared by the Home Railway companies up to the present have done little to assist prices in their own market. Certainly, the City and South London dividend, announced here last week, has caused a rise of another point to 44 in the Ordinary stock, but the unfortunate showing of the Metropolitan Company, more particularly as revealed in the report, has brought about a drop of 4½ points to 53½. With these District Ordinary stock sympathised, falling 2½ to 16½. Underground Notes are 2 down at 88. There has also been a steady decrease in the value of Central London, and the trio of Ordinary stocks is decidedly weak in anticipation of the dividend, which modified estimates have more recently put at 3½ per cent. on the Deferred.

Interest in the forthcoming interim statement by the British Electric Traction Company is deepened by the continued dulness of the prices of the shares. The Ordinary are down to 4½, and the Preference to 7¾, although the second Debenture stock has risen a point. It is not expected that the company will pay any interim dividend on its Ordinary shares. Other traction issues show little change, but the Anglo-Argentine group remains strong, the quotable change being a further rise of 1/16 in Anglo-Argentine Preference. British Columbia Electric Deferred has risen a point to 132½, and it is understood that a new land company is in the making, with the intention of doing for British Columbia what existing land companies are doing in Canada.

In the telegraph department, the Anglo-American Telegraph dividend, to be announced on Friday, January 25th, is to be 3½, according to the latest guesses. Prices, however, of this group are somewhat dominated by the position of the American Railroad market, with the consequence that Anglo "A" is slightly easier, although the Preferred is 1 per cent. to the good at 111½. The terrible disaster which has befallen Jamaica caused no noticeable change in any of the Telegraph shares. There is ½ fall in West India and Panama First Preference, but this can hardly be connected with the earthquake. Direct United States Cable shares are ½ down, but 4s. dividend was deducted, the price improving upon the issue of a satisfactory report. Amongst the Eastern stocks, Eastern Telegraph Ordinary, *ex* 1½, shows no alteration, although the report was by no means as satisfactory as some of the shareholders would have liked. The drop of ⅛ in Eastern Extension shares is covered by the dividend of a similar amount. Two or three of the prior charge stocks hardened half a point.

The market looks for the National Telephone dividend to be announced almost immediately, and the Deferred stock at 112 is again a little better. Chili Telephone shares at 7 are *ex* 3s., and have recovered the deduction. Oriental Telephone Debenture stock has moved up to 97½, and the shares are rather better at 1⅜.

Miscellaneous shares are quiet, and have withstood the prevailing depression elsewhere very well. Henleys are ¼ up at 11⅜, and the Debenture stock is also better. The advance in Willans and Robinson continues, the Ordinary and Preference both rising 10s., to 1⅜ and 3⅜ respectively, while the Debenture is a couple of points up at 77½. Crompton Ordinary shares are 2 1/16—a decided improvement on their previous price; the par value of the shares, of course, is £3. There was no change in British Westinghouse. Aron Meter Ordinary shares have pulled up to 4⅜, and the Preference to 14s. 9d. upon a little demand, which looks fairly shrewd.

The disappointment felt with the Edmundson's circular brought several sellers to market, with the consequence that the price of the Ordinary fell to £2. At this price other holders began to average, and the quotation moved up to 50s., which still shows a heavy drop on the week. Charing Cross Preference are ¼ lower, and St. James' Ordinary ¼ down. But City Preference gained a similar fraction at 12, and County Ordinary at 8⅜ were decidedly better. London Electric Ordinary moved up to 2¼. A fair amount of trade is being done here and at Liverpool in Rangoon 6 per cent. Preference, the price being 5⅛-¼ for the £5 shares fully paid.

Liverpool Overhead Railway Co.—The accounts for the past half-year show an available balance of £8,598. The directors recommend a dividend at the rate of 5 per cent. per annum on the (1892) preference shares, and a full year's dividend at the rate of 5 per cent. on the (1900) preference shares. The balance carried forward is £4,246, against £3,784.

Great Northern and City Railway Co.—The half-yearly meeting is to be held on February 4th, at Westminster Palace Hotel.

Central London Railway Co.—The directors have declared dividends of 4 per cent. on the ordinary, preferred and deferred stocks for the past half-year. £10,000 has been placed to reserve, and £14,608 is carried forward. The half-yearly meeting is to be held on February 6th at Holborn Restaurant, W.C.

Bahia Tramway, Light and Power Co., Ltd.—A meeting of the holders of the 5 per cent. gold debentures will be held on February 5th at 46, Threadneedle Street, E.C., to consider resolutions authorising the issue of further debentures not exceeding $4,000,000 for the purpose of extensions of the business.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 15th.	Closing Quotations Jan. 22nd.	Business done week ended Jan. 22nd, 1907. Highest.	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil		3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	61s.	2½%	3½%	..	67½ — 70	68 — 70	..	..	..	4 12 10
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6¼%	6 %	..	110 —111	111 —112	111⅞	110½	+1	5 7 2
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	¼%	..	27⅝ — 27⅞	27½ — 27⅞	28 5/16	27⅞	— ⅛	1 16 0
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛xd	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96⅛ — 98⅜	96¼ — 98½	98¼	97½	..	4 1 3
16,000	Cuba Telegraph	10	0 %	5 %	5 %	..	8½ — 9	8½ — 9	..	..	..	5 11 1
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	..	17 — 18	17 — 18	..	..	..	5 11 1
14,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9 — 9½	9 — 9¼	..	..	..	5 5 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	3 %	3½%	4½%	..	15⅝ — 16⅜	15⅝ — 16¼xd	16⅛	15⅝	..	5 4 7
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	137 —142	137 —142 xd	140½	138	..	4 18 7
2,000,000	Do. 5% Pref. Stock	100	5%	5%	5%	..	86½ — 88½	86 — 88 xd	87½	86½	..	3 14 7
1,496,766	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	105 —107	105½ —107⅜	106¼	..	+ ½	4 1 3
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜ — 13⅝	13⅜ — 13⅝xd	13⅝	13⅜	..	5 1 10
753,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	106 —108	106½ —108½	..	..	+ ½	3 12 9
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	..	99 —101 xd	100 —102	..	..	+1	3 18 5
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99 —101	99 —101	..	..	..	3 19 3
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	..	10⅛ — 10⅜	10⅛ — 10⅜	10 11/16	10⅜	..	5 2 4
121,127	Do. do. 5 % Pref	10	6 %	6 %	6 %	..	14 — 14½	14 — 14½	14⅜	14½	..	4 2 9
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	14 %	24%	..	37½ — 39½	37½ — 39½	..	..	..	6 6 6
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	..	58 — 60	58 — 60	..	..	..	5 8 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	7/8 — 1	7/8 — 1	19/4½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	..	..	..	4 8 11
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	4 16 5
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	110 —112	110 —112	111½	110¾	..	5 7 2
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	..	110 —112	110¾ -112½	111⅜	110½	+ ⅛	4 8 11
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	11 — 13	11 — 13	12⅜	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10 — 12	10 — 12	10 5/8	..	..	5 0 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	..	6¼ — 6⅝	6¼ — 6⅝	5⅝	5½	..	4 6 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98 xd	96 — 98	97⅜	96⅜	..	3 11 5
1,589,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100⅜	..	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	6¾%	7⅛%	..	1½ — 1⅝	1 7/16 — 1 1/2	27/-	26/6	+ 1/16	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅛ — 1½	1½ — 1½	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	95 — 97	96 — 99	97	..	+1½	4 0 10
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	98 —101	98 —101½	..	..	+ ½	3 18 10
11,839	Reuter's	8	5 %	5 %	5 %	..	7¾ — 8	7¾ — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 8
8,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	128	..	..	4 13 0
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅜ xd	6⅞ — 7⅜	6 29/32	..	..	5 7 7
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 11 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108 —111	108 —111	..	..	..	4 10 1
15,600	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	3/8 — ½	3/8 — ½	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	99½ —101½ xd	99 —102	..	..	+ ½	3 18 5
907,980	Western Telegraph, Ltd., Nos. 1 to 907,980 ..	10	7 %	7 %	7 %	..	13⅞ — 14½xd	13⅞ — 14½	14⅛	13⅜	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99 —102	101 —104	102½	..	+2	3 16 11
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	½ — ⅝	½ — ⅝	..	..	..	Nil
54,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	7⅞ — 7⅞	7 — 7½	6⅞	..	— ⅛	6 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛	8⅛	7 15/16	..	4 18 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½ %	5⅜ %	5⅜%	5½%	5⅜ — 5⅞xd	5⅜ — 5⅞	5⅞	5 11/16	+ 1/16	4 5 5
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	136 —139	136 —139	138⅛	137⅜	..	4 6 4
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —106	108 —106	105⅝	105	..	4 14 4
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	..	3⅞ — 4⅛	3¾ — 4⅛	81/3	80/-	..	4 14 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1 7/16 — 1 9/16	1 7/16 — 1 9/16	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	6 — 6½	6 — 6½	6 3/16	6 1/16	..	5 12 0
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	6½ — 6¾	6½ — 6¾	6¾	..	..	5 3 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¾ — 5¾	5¾ — 5¾	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	..	..	..	4 15 3
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	100 —103	100 —103	..	..	..	5 6 10
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	129 —134	130 —135	134	132½	+1	4 8 11
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	110 —114	110 —114	..	..	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	108 —112	108 —110 xd	..	..	..	4 10 11
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	103 —106	101 —104 xd	..	..	..	4 6 7
183,301	British Electric Traction	10	6 %	6 %	3 %	..	4⅛ — 4⅝	3⅞ — 4⅜	83/1½	82/6	— 1/16	6 17 2
161,487	Do. do. 6 % Cum. Pref.	10	6¾%	6 %	6 %	..	7⅞ — 8⅜	7⅞ — 8	8⅛	7⅞	— ⅜	7 10 0
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	108 —111	108 —111	109⅜	109	..	4 10 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	85 — 88	86 — 89	..	..	+1	5 1 2
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	..	6¾ — 7	6¾ — 7	..	..	..	5 14 3
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅞ — 6¼	5⅞ — 6¼	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102	101½	..	4 7 5
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	94 — 98	94 — 98	..	..	..	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1⅜ — 1⅞	1⅜ — 1⅞	31/10½	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	71 — 75 xd	71 — 75	..	..	..	5 6 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	8 — 11	8 — 11	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	..	3/4 — 1	3/4 — 1	..	..	..	5 0 0
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1⅜ — 1⅝	1⅜ — 1⅝	33/9½	32/6	..	8 14 7
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..	4 12 4
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83 xd	80 — 83	..	..	..	5 8 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	..	3⅜ — 3⅞	3⅜ — 3⅞	72/6	70/-	..	4 8 11
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	5 11 8
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	5 — 5⅛	5 — 5⅛	5 1/16	..	..	5 14 3
18,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	..	..	..	4 14 4
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	8½ — 8⅝	8½ — 8⅝	8 11/16	8 7/16	..	4 18 6
82,610	Do. 105,001 to 187,610	5	..	..	8 %	..	7⅞ — 8⅛xd	7⅞ — 8⅛	..	..	..	4 15 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5¼ — 5⅝	5¼ — 5⅝	5⅝	..	..	4 6 11
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	103 —106	103 —106	105	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	..	9½ — 10½	9½ — 10½	..	..	..	7 3 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5½ — 5⅝	6½ — 5⅝	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	7/16 — 9/16	7/16 — 9/16	10/3	10/-	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	..	1⅞ — 1 15/16	1⅞ — 1 15/16	..	..	..	5 1 1
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	..	82 — 84	80 — 82	82¼	80½	—2	4 17 7
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	..	98 —100	97 — 99	98⅜	98	—1	4 0 10
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	72 — 75	70 — 73	..	..	—2	5 9 7
1,480,000	City and South London Railway	Stock	2¾%	2¼%	1¾%	2¼%	42 — 44	43 — 45	44⅜	43¼	+1	4 14 5
85,000	Crompton & Co., Nos. 1 to 85,000	8	2¼%	2¼%	2¼%	..	1½ — 1⅝	1 5/16 — 2 5/16	..	..	+ 1/16	3 9 0
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 999 of £120, and 991 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..	5 3 1

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Jan. 15th.	Closing Quotations Jan. 22nd.	Business done week ended Jan. 22nd, 1907.		Rise + or Fall—	Present Yield per cent.
		†	1903.	1904.	1905.	1906.			Highest.	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 7/16 — 1 1/8	1 7/16 — 1 1/8	..	..	..	5 18 6
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000 ..	1	6 %	6 %	6 %		1 1/16 — 1 1/8	1 1/16 — 1 1/8	23/1 1/2	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6 %	..	14 — 15	14 — 15	..	..	..	4 0 0
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	14 — 15	14 — 15	..	..	..	4 0 0
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	2½%	4½%	..	1 1/8 — 1 1/8	1 1/8 — 1 1/8	30/-	..	..	8 6 9
17,189	Do. "A" shares, 01—017,189 ..	5	Nil	2½%	4½%	..	2 1/4 — 2 3/8	2 1/4 — 2 3/8	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	91½	..	..	5 5 3
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	1/4 — 7/16	3/4 — 7/8	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1 1/2 — 2	1 1/2 — 2	..	..	..	7 0 0
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	81 — 84 xd	..	..	..	4 15 3
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	5 %	8 5/8 — 9 1/8	8 5/8 — 9 1/8	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	8 %	4 %	4 %	4 %	3½ — 3⅝	3½ — 3⅝	75/-	..	..	11 18 9
98,000	Greenwood & Batley 7% Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10 — 10⅛	..	..	— ¼	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	99 -101	..	..	—2½	4 19 0
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	..	11 — 12	11¼ — 12¼	11⅜	11⅛	+ ¼	6 8 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 7/16 — 5 5/8	5 7/16 — 5 5/8	..	..	..	4 0 11
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106½ —108½	107⅜	107	+ ½	4 2 11
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10%	5 %	10%	10 %	15½ — 16¼xd	15½ — 16½	15½	..	..	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	..	1⅜ — 1⅝	1¼ — 1½	..	..	— ⅛	Nil
† 10,000	Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	..	6 — 7	6 — 7	..	..	..	7 2 10
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	8 %	..	7⅝ — 8	7⅝ — 8	..	..	..	3 15 6
899,930	Do. do. 60,008 to 100,000 (£6 paid) ..	10	8 %	6 %	8 %	..	3½ — 4⅛	3½ — 4⅛	..	..	..	4 0 6
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000 ..	10	5 %	5 %	5 %	5 %	8½ — 9⅛ xd	8½ — 9⅛	..	..	..	5 5 3
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 89	86 — 91	89½	88½	..	4 7 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/8 — 3/16	3/9	3/1½	+1/16	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/8 — 7/16	3/8 — 7/16	18/9	17/6	..	5 3 11
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	95 — 98	95 — 98	97½	96½	..	4 11 10
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 5/8 — 4 13/16	4 5/8 — 4 13/16	..	..	..	6 10 8
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	5 %	5 %	4 %	..	6 — 7	6 — 7	..	..	..	5 14 4
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	5 %	5 %	5 %	..	7 — 8	7 — 8	..	..	..	6 5 0
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	98½ —101½	98½ —101½	..	..	..	4 8 8
87,350	Telegraph Construction and Maintenance ..	12	20 %	15 %	15 %	..	30 — 32	30 — 32	..	..	..	5 16 3
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	99½ —102½ xd	100 —103	..	..	+ ½	3 17 8
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts. ..	..	..	5 %	5 %	5 %	89 — 91	87 — 89	..	..	—2	5 12 4
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1 — 1½	1½ — 2	38/9	31/3	+ ½	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3 — 3½	3½ — 4	73/9	70/7½	+ ½	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	73 — 78	75 — 80	77	..	+2	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅓%	5⅓%	..	5 — 5⅓	5 — 5⅓	5	..	..	5 0 0
70,000	Do. do. 4½ % 1st. deb. stock ..	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	8 — 9	8 — 9	8¼	..	..	5 11 1
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7⅞ — 8	7⅞ — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	..	101 —104	101 —104	..	..	..	3 16 11
80,000	Charing Cross and Strand Electricity Supply ..	5	8 %	8 %	5 %	..	3½ — 4¼	3½ — 4¼	73/9	..	— ⅛	5 17 8
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4¼ — 4⅜	4⅛ — 4⅜	87/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4	3⅞ — 4	..	..	..	5 12 6
427,400	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4½%	100 —103	99 —102	..	..	— 1	3 18 5
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	..	5 — 5⅓	5 — 5⅓	5½	..	..	5 9 1
175,000	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½%	4½%	4½%	4½%	104 —107 xd	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	..	9½ — 10⅛	9⅝ — 10⅛	10 5/8	..	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11 — 12	11⅛ — 12⅛	11⅝	..	+ ⅛	4 18 6
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124 xd	121 —124	..	..	—2	4 0 8
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	98 —101	98½	..	..	4 9 1
40,000	County of Durham Electrical Power, Ord.	4	4 %	£3 7 0	4 %	..	2 1/8 — 3 1/8	3 1/8 — 4 1/16	..	..	+1	3 16 2
50,000	Do. do. do. 5 % Pref. ..	5	5 %	5 %	5 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 15 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	..	7⅛ — 8⅛	8 1/16 — 9⅛	8 7/16	8⅜	+ ⅛	5 8 1
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10¼ — 11⅛	10⅝ — 11⅛	10⅝	..	..	5 4 4
400,000	Do. do. 4½ % Deb. Stock ..	..	4½%	4½%	4½%	4½%	105 —108 xd	105 —108	108	..	..	4 3 4
400,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	99½	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	4 %	..	1 3/8 — 2 3/8	2 — 3	50/-	40/-	+ ⅛	6 13 4
80,000	Do. do. 6 % Cum. Pref.... ..	5	6 %	6 %	6 %	..	4 1/8 — 4 1/8	3 7/8 — 4 3/8	87/6	80/-	— ⅛	6 6 4
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	97 —100	93 — 97 xd	97½	95¼	..	4 12 9
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 17 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	..	7⅞ — 8½	7⅞ — 8½	..	..	..	5 9 1
21,000	Kensington and Knightsbridge Electric Ord. ..	5	12½	12 %	10 %	..	9½ — 10⅛	9½ — 10⅛	..	..	..	4 17 7
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..	3 18 5
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	..	1⅞ — 2⅜	2 — 2½	47/6	43/9	+ ⅛	4 17 0
70,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	3 14 3
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 1 8
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	..	7⅜ — 8⅛	7⅛ — 8⅜	..	..	..	5 17 8
76,121	Do. 4½ % Cum. Pref. 1—71,106 ..	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝ xd	5⅜ — 5⅝	..	..	..	4 3 9
220,000	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½%	4½%	4½%	4½%	106 —110 xd	106 —110	..	..	..	4 1 10
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	94 — 96 xd	94 — 96	..	..	..	3 12 11
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	97 —100 xd	97 —100	..	..	..	4 10 0
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	..	7⅞ — 8	7⅞ — 8	..	..	..	5 0 0
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	..	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 1 8
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	..	13 — 14	13 — 14	..	..	..	5 7 2
64,000	Do. do. 4 % 1st Mort. Deb... ..	100	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..	4 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	..	6 — 6½	6 — 6½	..	..	..	5 7 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	98 —100	96 — 98 xd	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½%	14½%	12½%	..	9½ — 10½	9 — 10	9 1/16	..	— ⅛	6 5 0
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	..	7 — 8	7 — 8	..	..	..	4 7 6
150,000	Do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	3½%	94 — 96 xd	94 — 96	..	..	..	3 12 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	..	1⅛ — 2⅜	1⅛ — 2⅛	..	..	..	8 0 0
80,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	73 — 77	73 — 77	74½	78⅛	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..	6 3 1
120,000	South Met. Elec. Lt. & Power, Ord..	1	Nil	Nil	2½%	..	— —	— —	..	..	..	3 6 8
117,968	Do. Do. 7 % Pref.... ..	1	7 %	7 %	7 %	..	1⅜ — 1⅝	1⅜ — 1⅝	26/-	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	2⅜ — 3⅜	2⅜ — 3⅜	60/-	..	..	6 13 4
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4 — 4½	4 — 4½	80/-	..	..	5 11 1
220,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	..	99 —102	99 —102	99	..	..	4 8 3
110,000	Westminster Electric Supply, Ord.	5	12½%	14 %	18 %	..	9 — 10	9 — 10	9 1/8	9⅞	..	6 10 0
81,279	Do do. 4½ % Cum. Pref. .. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	4½%	5¼ — 5⅝	5¼ — 5⅝	5½	5 5/8	..	3 18 3

Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 72—74.
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

Bank rate of discount 5 per cent. January 17th, 1907.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING DECEMBER, 1906.

Compared with the extraordinarily high values which we recorded for November, the present (December) returns show a very considerable falling off; they, however, compare very well with the average values obtaining in both 1905 and 1906, as will be shown. For the month in question, the value of the exports amounted to £148,077; of the imports, £137,250; and of the re-exports, £10,358, and these compare with totals of £197,486, £154,269 and £24,451 respectively, in the month of November.

The export total of £148,077, is, however, much in excess of the average of the previous 10 months in 1906, viz., £134,897, as also of the 1905 average, £112,381, and, in fact, it confirms the steady improvement in business which is generally admitted.

With the imports, however, some falling off is noticeable, as the total for the month, £137,250, is considerably below the 10 months' average, viz., £146,520, although an improvement on the average of 1905, viz., £122,224.

In the case of the re-exports, the value recorded is considerably below the average of the previous months of 1906, but in excess of the 1905 average.

The individual items of both exports and imports are, as might be expected, generally less in value than in November, but still attain very satisfactory totals; a considerable export of tramway material to Brazil is prominent, and one item of wireless telegraph material to the Argentine. Our South African and Indian possessions, together with the South American Republics and Japan, were prominent buyers, as usual.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	107	601	129	10	16	804	5	...	...	...	...
Germany	564	330	56	43	33	1,362	5	...	10	...	...
Netherlands	78	453	281	10	...	456	...	...	...	...	...
Dutch Borneo and Java	15	...	15	27	...	1,504	...	...	10	...	...
Belgium	233	...	86	...	26	661	...	...	777	...	...
France	311	...	106	5	40	218	629	...	...	13	...
French Indo-China and West Africa	...	...	2	...	9	...	1	...	2	...	...
Portugal, Madeira and Portuguese Africa ...	327	6	158	18	36	259	...	36	...	63	...
Spain and Canary Isles	468	191	90	6	268	44	...	...	587	923	...
Italy and Austria-Hungary	88	...	3	190	482	911	...	...	...	...	...
Greece, Roumania, Turkey and Persia	80	...	40	...	...	30	...	...	4	...	...
Egypt	747	74	220	22	186	68	66	...	56	...	...
China, Siam and Korea	211	342	717	142	103	54	10	...	...	...	...
Japan	37	16,314	233	...	330	2,268	25	...	13	3,770	...
U.S.A. and Havti	...	...	16	595	8	510	...	...	...	...	...
Mexico, Peru, Uruguay and Paraguay	65	2,945	17	27	...	...	...	4	...	3,345	...
Chili	49	40	...	96	...	763	47	...	16	12	...
Brazil	614	83	4	657	...	3,776	...	39	...	...	8,888
Argentine	1,535	13,329	321	168	369	1,599	1,338	144	1,360	1,211	...
Channel Isles, Gibraltar and Malta	263	...	95	12	17	1,045	2	2	11	...	25
British West Africa	26	...	19	...	...	53	...	...	18	36	...
Cape of Good Hope	773	450	324	36	35	2,116	1,179	...	31	17	...
Natal	646	1,161	672	374	192	622	16	...	112	...	...
Zanzibar, British East Africa and Mauritius ...	..	...	146	11	...	...	25	...	32	...	...
India	866	7,293	379	754	694	15,936	141	192	36	721	31
Burmah	1,101	1,105	645	21	21	50	9	...	...	856	...
Ceylon	149	151	155	10	2	178	44	...	...	...	...
Straits Settlements and Sarawak	245	9	373	15	...	103	...	161	8	251	...
Hong Kong	27	379	56	169	8	...	8	8	23	3,881	...
West Australia	330	253	106	190	92	299	...	...	...	...	...
South Australia	347	602	55	54	...	90	...	...	...	...	...
Victoria	196	1,030	141	7	...	779	...	60	14	58	...
New South Wales	1,532	939	261	363	73	2,849	85	...	110	1,360	...
Queensland	60	75	47	...	20	11	...	...	...	...	...
Tasmania	128	...	...	...	...	...	...	...	...	...	...
New Zealand	369	145	177	21	...	413	24	...	498	3	...
Canada and Newfoundland	309	...	167	8	42	25	...	...	...	...	...
British West Indies, British Guiana and Falkland Islands	19	...	3	20	...	...	6	...	5	...	...
Total, £	12,915	48,300	6,315	4,081	3,102	39,856	3,665	646	3,733	16,520	8,944

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	20	342	...	40	...	1,037	210	18	9,891	...	...
Holland	534	7,057	895	10,194	103	1,798	1,157	3,867	821	25	...
Germany	2,996	6,301	1,438	1,969	139	13,387	346	1,755	1,166	...	...
Belgium	1,096	5,464	364	7,151	192	9,485	338	1,883	9,800	525	...
France	386	4,902	2,833	318	1,029	973	596	2,790	1,663	...	...
United States	1,950	651	1,074	82	15	12,426	4	132	15	500	...
Victoria and New South Wales	107	...	...	...	...	...	...	...	...	...	...
Total, £	7,089	24,717	6,604	19,754	1,478	39,106	2,651	10,445	23,356	1,050	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	2,257	1,089	16	51	33	2,365	1,788	122	2,633	4	...

Total Exports: £148,077

Total Re-Exports: £10,358

Total Imports: £137,250

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

NOTES ON THE EVOLUTION OF CANAL ELECTRIFICATION METHODS.

By B. H. THWAITE, C.E.

(*Concluded from page* 126.)

The Automobile Canal Tractor (*French Experiments*).—The automobile canal tractor weighs 2½ tons, and is of the three-wheeled type. It is stated to be quite capable of towing a standard (French) type of canal barge (117 ft. in length by 16 ft. in width), capable of carrying with full 70 in. of draught a cargo of 290 tons; although, of course, the adhesion of the road surface is greater than that of a metallic rail surface, there will be a corresponding additional expenditure in haulage energy. Occasionally the Douai canal automobile tractor is dragged into the canal.

The system is now being superseded by the system E, which, obviously, has been copied from that originally tried on the Finow Canal, and forming also the basis of the same system applied on the New Teltow Canal, near Berlin. The Teltow Canal (one of the latest examples of the German Government's enterprise in assisting the industrial and commercial interests of the country), connects the River Spree to the River Havel. The canal is 38 km. (23½ miles) long and 68 ft. wide, and has a draught of over 6 ft.

Messrs. Siemens & Halske, as a result of their experimental work on the Finow Canal, were asked to submit a design for a canal electric tractor, which was adopted, and which is illustrated in fig. 2.

The tractor is proportioned, in its haulage capacity, to deal with two fully-loaded barges of 600 tons capacity each.

The tractor consists of a four-wheeled truck and a pair of trailing wheels; each axle of the truck is driven by an 8-H.P. 500-volt series motor running at 800 R.P.M.

Speed in kilometres per hour.	Pull or tow rope tension in kilogrammes per ton of cargo.	Power consumption per ton of cargo, kilowatts.	Energy consumption in kw.-hours per ton per kilometre.
4 km.	0·85 kg.	0·014 kw.	3·5 kw.-hours.
4·5 km.	1·035 kg.	0·021 kw.	4·25 kw. „
5·0 km.	1·34 kg.	0·084 kw.	5·25 kw. „

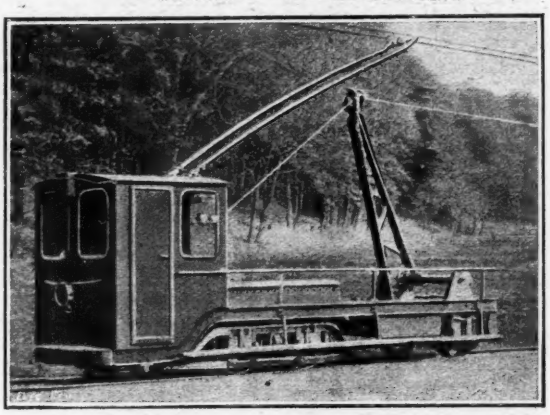
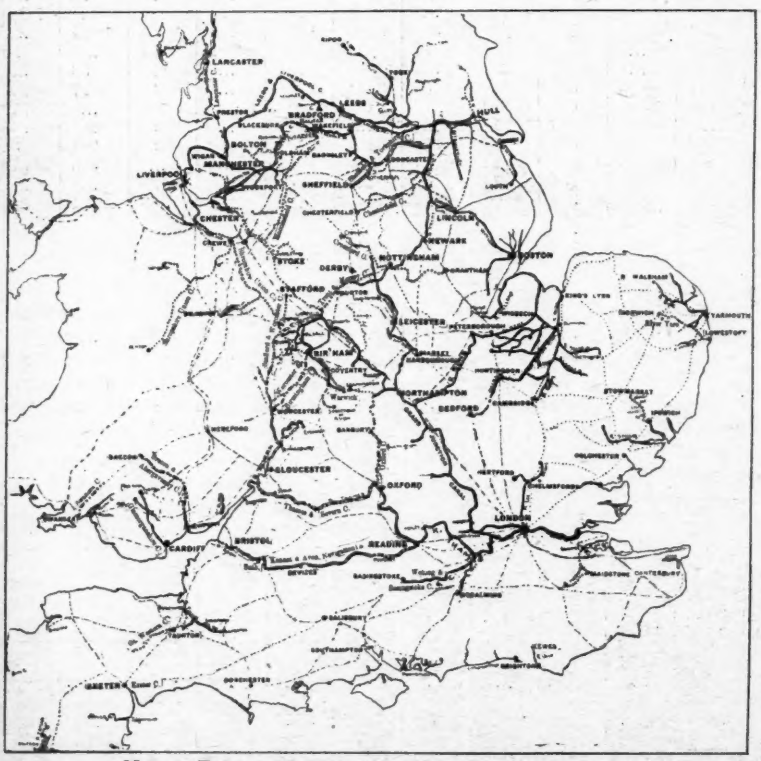


Fig. 2.—Siemens & Halske Electric Tractor.



Map of Existing British Canal Routes. (See page 164.)

The necessary elastic starting pull is obtained by means of a drum mounted on the trail end of the tractor. This drum is driven through worm gearing by means of a high-speed 3-H.P. motor running at 1,460 R.P.M.

If the effort for overcoming the inertia of the barges exceeds that of a pull of 2,000 kg., then the drum slips back on its shaft; by this means the tractor is enabled to assume the haulage load without too much violence, which might lead to the overturning of the tractor. As a further precaution against this tendency, the rail on the canal edge of the towpath is super-elevated three-quarters of an inch.

The total weight of this tractor is some 7,500 kg. (about 7½ tons); a test made in 1904 gave a mean tractive efficiency of 65 per cent.

The following table gives the ratio of the speed to the expenditure of electric energy :—

A guide arm manipulates the 10-mm. wire towing rope; the guide rope is actuated by means of a 3-H.P motor and associated bevel gearing.

The Douai Electric Canal Tractor System (*French Experiments*).—The tractor on the Canal d'Aire at Douai, Northern France, is designed broadly on the lines of the type in service on the Teltow Canal; the differentiation is in the method of dealing with the towing rope problem (see fig. 3). For instance, the barges are each fitted with towing masts 30 ft. high, easily elevated and easily lowered. When two barges meet, the towing mast of one of them is lowered to pass under the tow-rope of the other.

The standard barges on the French canals have a load capacity of 290 tons.

The Douai Canal is 63 ft. wide and 7 ft. 6 in. deep; the tractor weighs some 8 tons, each of the two axles is driven by a 20-H.P. motor, and the motors run in series. The normal consumption of power is only a quarter of the rated full capacity, so that there is more than ample margin for extra effort in overcoming the inertia of the barges, or other special demands; the normal consumption is given as being equal to some 13½ E.H.P. (20 amps. at 500 volts is the current strength). As there is only a single rail track, the tractor motors are reversible; when two tractors meet, the tow ropes are exchanged and the direction of the two tractors is reversed.

The economy of this E system, as applied at Douai, appears to be demonstrated by the proportions fixed for maximum tariff both for up and for down stream. For up stream the maximum tariff is fixed at 0·004 fr. per ton per kilometre; for down stream, 0·0035 fr. per ton per kilometre; say, 0·05d. to 0·06d. per ton-mile.

The Objections to Heavy Towpath Electric Tractors.—The objections to the heavy type of canal electro-tractors are these :—

1. The weight of the tractor has to be added to the weight of the floating vessel and its cargo.

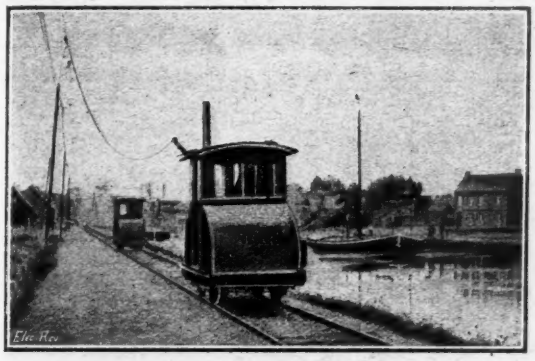


Fig. 3.—Douai Canal System.

2. The weight of the tractor is, and obviously must be, proportioned for the maximum haulage pull the canal service demands ; and

3. Consequently it is in excess for all the cargoes below this maximum.

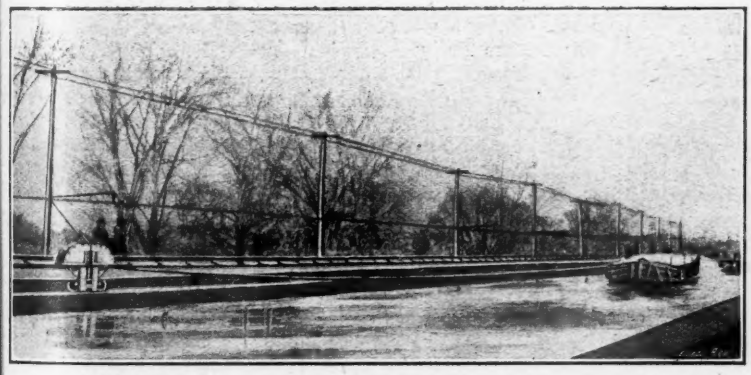


Fig. 4.—Erie Canal System.

4. Only one track can be provided along the towpath of normal width, so that the direction of the tractors has to be reversed and the towrope has to be exchanged both for varying speeds and contrary directions.

5. The construction of the towpath and the rails of the track are proportioned to this heavy tractor weight, which is greatly in excess of average requirements.

6. The towpath must be retained—a serious objection—because it is desirable that the British canals should be widened at the expense of the towpath.

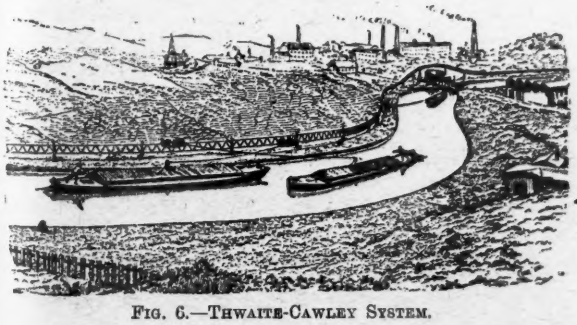


Fig. 6.—Thwaite-Cawley System.

The Erie Canal—Wood's Modification of the Thwaite-Cawley System (American Experiments).—The system F, including in general principle that of G, has been tested experimentally on a length of 2,700 ft. of the Erie Canal. The track is for a certain length quite straight, the remaining length consisting of a sharp curve.

The engineer responsible for the design (see figs. 4 and 5) is Mr. S. Wood, of New York, but as the *Electrical World* (N.Y.), of November, 1903, clearly states, it is similar to that of Thwaite and Cawley, of England. The similarity is in the general haulage methods adopted; there are merely structural differences in the application. In the Erie Canal demonstration two superposed (but not in vertical line) 18-in. steel girders (the one the furthest from the canal being the highest) are located on the tow-path, being supported on short posts, erected every 25 ft. along the tow-path.

The results of the tests show a higher efficiency than can be claimed for the system E, but the spreading of the steel girders absorbs more tow-path width than is really necessary, and would make the system difficult to apply on the average British Canal ; this deviation from the Thwaite-Cawley direct vertical line girder system is certainly a mistake, it would mean the retention of the existing tow-path. Over the two superposed steel girder tracks there extends a series of ordinary trolley brackets carried on poles, set at the outer edge of the tow-path.

The electric tractor consists of two 40-h.p. reversible motors of the ordinary narrow gauge tramway type, geared down (4 to 1) to a suitable traction speed. Each motor drives a grooved wheel, which travels upon its rail.

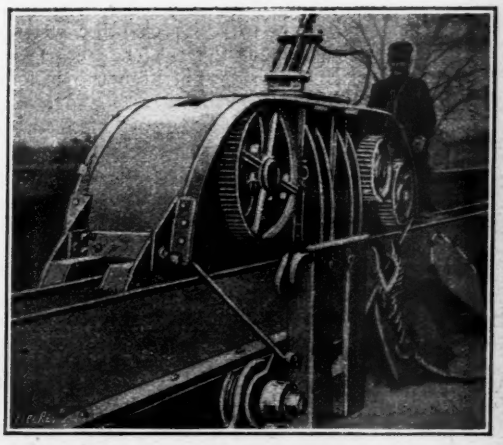


Fig. 5.—Erie Canal Tractor.

The tractor is equipped with a street-car type of parallel controller and resistance box. The tractor is intended to act on the grip principle of the Thwaite-Cawley system, but its weight, between 5 and 6 tons, is altogether too heavy to secure the full benefits of this proportionate adhesion

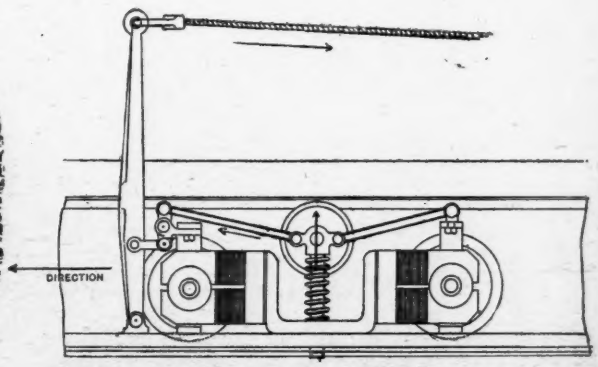


Fig. 7.—Proportionate Adhesion Device.

principle. The pressure is that generally utilised in European practice, *i.e.*, 500 volts.

The permanent way of this system is estimated to cost £3,700 per mile. The tractors will cost £500 each.

The British Thwaite-Cawley System of Proportional Adhesion.—The Thwaite-Cawley system G (see figs. 6 and 7), has often been described in the British Press; the system was lucidly described in a paper read before the British Association meeting of 1898, by Mr. A. H. Allen, A.I.E.E.*

The main objects of this pioneer system of canal electrification are briefly set forth in the following statement:—To secure the highest possible tractive efficiency so that the system will not only be more economical than horse haulage, applied under the best conditions, but also will permit the widening of British canals by the suppression of three-quarters of the width of the tow-path, and this without involving the use of a screw propeller.

The system provides a comparatively light tractor, that relies for its adhesion to the track almost entirely on the pull of the tow rope.

If the load carried in the boat is light, the adhesion is proportionately light. If the load carried is heavy, the adhesion is proportionate thereto.

The consumption of current would, therefore, correlate with the adhesion, and automatically, and there would be no waste of current in hauling dead weight of tractor. The mechanical leverage arrangement, by which this proportionate adhesion is accomplished, will be readily understood by the diagram fig. 7.

The Thwaite-Cawley system was originally designed in 1894 to satisfy the peculiar exigencies of the British canal system. The permanent way consists of two special section girders, one mounted over the other in such a way as to permit two tractors to pass each other when running in opposite directions; as the tractors are standardised, the tow-ropes can be exchanged between two motors travelling at different speeds but in the same direction.

The supporting stanchions or posts are placed at distances depending upon the maximum loads carried by the boats in the particular length of the canal. The posts are built along the outer edges of the towpath, and are embedded in concrete. The weight of the tractor is about 10 to 15 cwt. for 75-ton boats. Special coil-spring capstans are the only additions to existing boats; these will provide the necessary elasticity for starting operations.

The application of this G System to British canals awaits the decision of the Canal Commission. It is admitted by such eminent canal experts as Sir Leader Williams, Mr. Marshall Stevens, and others, that the System G is suitable for application to British canals. The estimated cost of canal haulage in the Thwaite-Cawley System G is as follows:—

Speed 2½ miles per hour—cost per ton-mile, 0·032d.
„ 4 „ „ „ „ 0·041d.

The cost per mile, including suction-gas electric generating stations, permanent way, and electric transmission equipment, will not, it is estimated, exceed £2,300 per mile. The tractors, with proportional haulage gear for hauling 100-ton barges, will cost £150 to £175 each.

To secure the highest efficiency in the generation of the electric power to supply canal-boat haulage demands, and assuming that a bulk supply is not available,† it is desirable to distribute the generating stations along the canal route, their power capacities being proportionate to the maximum traffic on the respective canal sections fed by such stations.

The author recommends that the power system of the stations shall be suction or pressure gas, the engines in multiple units being so arranged that the active units shall, as far as practicable, be maintained at full or ¾ load.

All the stations being telephonically connected, they should work in complete sympathy.

The generating stations might be located at every 20 miles in the length of the canal.

In the Douai (French) installation there are at present three small and distributed steam-power stations, but the programme of developments of the immediate future includes the putting down of a central generating station at Pont de Vendin, near to a large battery of coke ovens (it is presumed that the waste gases from the coke ovens will be utilised to develop the power). Three-phase current will be produced at 26,000 volts to be transformed (to 500 D.C.) in the sub-stations (now generating stations).

The use of electricity on modern canals is by no means confined to traction purposes. It has for long been employed on the Soulanges Canal, in Canada, in this case for powerful arc lighting. Arcs of 2,000 C.P. are placed high above the canal tow-path at intervals of 160 yards, allowing night operations to be carried on; and on other Canadian canals the electric energy is being applied to actuate both canal lock and sluice gates, and for rotating swing cross-bridges.

In twin locks of modern canals, the water from the lowering-boat lock is utilised to the extent of 50 per cent. for the raising-boat lock, the balance of the water being raised by electrically-driven centrifugal pumps to the higher level or into the raising-boat lock.

Lock-gates are electrically hoisted or swung round. Capstans and winches are rotated for local and special haulage work.

The electric power is also available for electrically lighting the warehouses and providing power for cranes, elevators, and conveyors, and for driving the machinery of factories located along the canal banks.

Extensive use has been made of the electric service at the Teltow Canal installation.

An adequate conception of the possibilities of usefulness to the nation of our canals, if revived and modernised, can only be obtained by a full realisation of the magnitude and scope of the electrical service applied to them, not only for traction, but for stimulating the creation of new industrial establishments alongside the canals.

The Future Policy Regarding our Canal System.—The full transport possibilities of our canals will only be secured by the assistance of the State in the work of standardising, co-ordinating and electrifying selected lengths of our canals that can be proved to have an economic (existing or possible future) basis for the line of route they occupy.

The work of restoration will include the deepening and widening of the canals (by the suppression of the tow-paths), the side-by-side duplication and the enlargement of the locks to double their present capacity, so that boats of steel, with the minimum ratio of tare weight to the cargo capacity of 75 to 100 tons, can be used and electrically hauled; also the allocation of new watershed areas for the canal hydraulic supply, and, in addition, the provision along the length of the canals of artesian wells, with electrically actuated pumps, the current for which can be tapped from the main that provides the electric haulage power.

Encouragement should also be held out to manufacturers to locate their factories right on the canal banks, because such works could be supplied not only with cheap transport facilities, but also with bulk electric power and the refrigerating and other services that a ready supply of water provides.

To increase the transport capacity of the trunk canals, waterway sidings could be provided at certain selected points along the canal, to serve the same purpose as the sidings of single railway or tramway systems.

The State might, in the first instance, secure control of the existing canal routes, whether independently or railway owned, which connect the heart of our canal system around Birmingham, with London, and, by a future extension, with Southampton in the south, and with Chester, Liverpool, Manchester, Leeds, Lincoln and Hull in the north. The line of these existing canal routes can easily be traced on the map which appears on page 162. Where two connecting routes exist, the most suitable would be selected for revivification.

The Government, by reference to the provisions of the very many Canal Acts, will probably find that the canal companies that have operated, or are now operating, under these Acts have *not* fulfilled the obligations to the State imposed by the Acts.

Therefore the State has rights of possession that private trusts, acting outside the ægis of the State, could not assume; *ergo*, the work of reviving and modernising our canals should consequently, as it is in Germany, France, Belgium and Austria, be purely an affair of the State, and be quite outside railway influences, direct or indirect.

* Electrical Review, September 30th, 1898, p. 505.

† The Yorkshire Power Act includes a clause giving power to supply Yorkshire canals, within the authorised distributing area, with energy in bulk. The exhibition of a scale model of the Thwaite-Cawley G System of Canal Electrification before the Lords' Committee enabled the promoters to obtain this clause.

PROCEEDINGS OF INSTITUTIONS.

New Incandescent Lamps.

By J. Swinburne, F.R.S., Past-President.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *January 10th*, 1907.)

From 1880 until quite recently it seems to have been generally taken for granted that no departure from carbon was possible. Certainly, there were some experiments on silicon. As silicon is very closely related to carbon, it seemed likely that it would make a good filament, but nothing came of it. Attempts were also made to coat carbon filaments with silicon and with boron.

It may seem strange that people did not experiment on some of the more refractory metals; but a little consideration will explain matters to some extent. In the first place, the interest was small. Now, when lamps are made by the million, an improvement means a fortune to the inventor. The result is that there are far more people, and especially far more very highly trained men, working on the subject now. Another point is, that in the early days very little was known about most of the refractory metals. During this time, for example, such substances as thoria, ceria, zirconia, and other "rare earths," have become quite familiar to the practical chemist. Again, we have become much more familiar with high temperatures and high melting points through working with the electric furnace.

Carbon lamp makers have now been able to make 200-volt lamps, even of small powers, for some years. When it is remembered that the process of squirting a solution of cellulose into a liquid is now employed for making artificial silk, it will be realised that squirting enables the lamp-maker to make his filaments as fine as he likes. The difficulty, then, is not in making a sufficiently fine thread in the first place, but in mounting it, and above all, in getting a durable lamp of such fine material. If the surface emission is the same, the pressure varies directly as the square root of the cube of the length of the filament. Other things being equal, a 200-volt filament is nearly 1·56 times the length of the 100-volt conductor, and about two-thirds of the diameter. It is thus very much weaker. The slow wearing of the surface causes a greater percentage difference in the resistance of the lamp; and there is double the pressure available for causing discharge across from one leg of the filament to the other. The only way the lamp-maker can reach high pressures, other things being equal, is by increasing the size of the lamp, that is to say, making 16 instead of 8-candle lamps, and so on.

We have thus the distribution engineer clamouring for high pressures, and the lamp-maker trying to meet his demand, and making up to 250-volt lamps. The lamps are naturally worse than those made for lower pressures, but the combination of better distribution and worse lamp is on the whole much better for the public, as the gain through better distribution is greater than the loss through inferior lamps.

An American improvement has been introduced by Mr. Howell. The carbon filaments are heated in an electrical furnace to convert them into a form of graphite. This is really perfecting an old process rather than inventing a new one. The effects of high temperature were known long ago.

But as soon as we deal with metal lamps the question of distribution comes up again. How are lamp-makers to get the metal wire so fine that it will take, say, 200 volts? The metal lamp can only supplant the carbon on the ground of higher efficiency, and the efficiency claimed is much higher. Thus if a carbon lamp of 200 volts and 16 candles has an efficiency of 0·25 candle per watt, it must have a resistance of 625 ohms. To make a carbon of 625 ohms small enough to give 20 candles at 0·25 c.p.w. is a feat, but to make a metal wire to do so is a very difficult matter. But a metal lamp is made to work at, say, 0·75 c.p.w., and that means that for 16 candles there are only 21·4 watts. This means a resistance of 1,870, or nearly 2,000 ohms. To make a lamp filament of metal so as to have a resistance of 2,000 ohms, and only to give 16 candles at a temperature necessary to give such a high efficiency as 0·75 c.p.w., would be a wonderful feat. There are two influences which help the metal lamp, however; the resistance of the metal rises considerably with the temperature, as a metal is run not very far from its softening point, and the emissivity of bright metal is less than carbon, so that to give the same light at the same efficiency the wire may be larger. It seems probable, however, that bright metal services increase in emissivity as they get hot, that is to say, they get blacker as they get hotter; a black body being brighter at a given high temperature than a white body.

We thus come upon the weak point of the metallic lamp; it is very difficult to make a small lamp of 200 volts. The questions are, therefore, whether the higher efficiency of the metal lamp will induce us to bring our pressure down to 100 volts or less, on the one hand, or whether the metal lamp can be made to take 200 volts or more either by further perfection by the use of some sort of transformer, or by using larger lamps, say, 50 candles each. Of course, we may take to running the lamps in pairs, or in threes in series, but that does not seem likely. We went through a good deal of trouble of that sort in the early days of the carbon lamp, and it is improbable it will be repeated. Large buildings may be wired on the three-wire system with a dead middle wire; but this does not appeal very strongly to modern engineers, and it is only applicable to new buildings that are not yet wired. If the metallic lamp had come into being 20 years ago it would have commanded its own conditions, but now it has to adapt itself to the conditions already existing. The average householder will certainly not put in a special transformer to give him 100 volts, and it will take a good deal of persuasion to induce a supply company to convert its three-wire into a five-wire system. At the same time it must be remembered that there are still plenty of 100-volt circuits, and the output necessary to supply these is quite great enough to give the metal lamp a footing which may enable it to prescribe its own conditions in the future. It seems probable, however, that people's ideas of the value of light will alter, and that incandescent gas or large metal lamps will soon lead them to use 50 candles as the normal light at each point. At the same time, the ingenuity which has made metal lamps possible seems quite capable of making 200-volt 16-candle lamps within reasonable time.

When we come to the question, What metals or compounds are available for lamp filaments? we have to consider the melting point, the specific resistance, and the possibility of making the filaments in practice. As to the melting point, it has been quite impossible to melt many of the metals until the electric furnace came into use; but the electric furnace generally deals with the metals in the presence of carbon, which probably alters their melting points. But apart from that, before the recent development of the study of radiation, there was no means of measuring such temperatures as the fusing point of tungsten, for example. Even yet we have no data as to the melting points of most of the refractory metals. The best guide available is the Periodic Law. By using elements whose melting points are known to be high as a sort of guide posts, we can pick out the elements most likely to have high melting points.

The high melting points correspond with small atomic volumes. Electrical conductivity seems to follow the same sort of rule.

In making metal or carbide filaments there are several processes.

A carbon filament may be made first, and this may be coated by electrical heating with other substances, and the carbon can then be volatilised.

The same process can be carried out except that the carbon, instead of being volatilised, is combined, making a carbide. A wire may be deposited electrolytically from a solution.

The material may be ductile, in which case it is drawn into wire in the usual way.

The material may be made into a very fine, smooth powder, and mixed with some agglomerant, and squirted. The squirted filament is then dried, baked, and heated electrically to get rid of carbon if an organic binding material has been used.

An oxide may be mixed with carbon and made into a paste and squirted. The filaments, after baking, are heated electrically *in vacuo;* the carbon then reduces the oxide, making either metal or carbide according to the proportion of carbon employed. The carbon may be supplied by heating in hydrocarbon vapour.

The oxide may be made into a rod and run like a Nernst lamp, except that the process is carried out either *in vacuo* or in hydrocarbon gas, so that the oxygen is removed, leaving metal.

These are the most likely, or the least unlikely ways of making filaments.

The plan of coating a carbon and then volatilising the carbon by heat has a heroic ring about it, which promises a lamp capable of very high efficiency; but I want to see it done. Most metals are likely to form carbides rather than let the carbon go off.

The electrical deposition of metal filaments is generally troublesome because most of the metals that might do for lamps will not deposit uniformly enough, and electrolytic deposits of hard metals are not capable of being drawn down into wire. For such a process to be successful the core or mandrel must not be made of a metal that will form an alloy. It need not necessarily be metal at all; presumably such a material as nitrocellulose coated with blacklead, or made conductive by any of the ordinary methods, would serve. The resulting filaments would be tubes, of course.

Drawing down fine wire is generally impossible, as few of the metals are ductile. The drawing down of tantalum by Messrs. Siemens & Halske is a perfect triumph when not only the real but the reputed properties of that metal are considered. Tantalum is not soluble in the ordinary acids.

The metal filament is very seriously handicapped by its softness when hot and its brittleness when cold. Many of the metal lamps will run only in one position, otherwise the wire sags. The wires are also often very fragile when the lamp is not in use.

It might be urged that alloys should be used for lamp wires, on the ground that many brittle and intractable metals may make ductile alloys. Alloys have generally high specific resistances, and this is, of course, a very great point. Even a very small addition of another metal may increase the specific resistance very considerably. Unfortunately, alloys generally have low fusing points. Where a very fusible and a refractory metal are alloyed, the addition of the refractory to the fusible metal generally first lowers the melting point. The melting point then rises in one way or another, according to whether definite combinations occur, until the melting point of the refractory metal is reached. If the metals have about the same melting point, their alloy may be taken as having a lower melting point. This is not a law, however. It is possible, therefore, that alloys may be formed which have very high melting points. Perhaps metals of the same group and series may give refractory alloys. Platinum-iridium has, I believe, a high melting point. Tungsten and osmium are in the same series, but are in the sixth and eighth groups. Tantalum and tungsten are in the same series and neighbouring groups.

The addition of a very little of one metal to another may be worth while if it increases the specific resistance very considerably and lowers the melting point very little. The alloys with high melting points generally contain definite compounds, and compounds are often much more infusible than their components.

Alloying has a possible disadvantage in reducing the resistance-temperature coefficient. The rise of resistance is a most valuable property in a wire lamp, as it protects the lamp against over-running, and allows it to be run bright on a more variable supply circuit.

One of the difficulties in squirting filaments of a paste of finely divided metals and an agglutinant is to get the metal fine enough to squirt smoothly. This is also a question of the agglomerant used. Some of these metals in the form of powder will not squirt properly; the paste comes out thin at first, and then particles choke the nozzle and the squirting stops. Gum tragacanth is a very convenient material to use. It was used by Farneljehm for squirting thin threads of magnesia, out of which he made beautiful little baskets for use as mantles on water-gas burners. These have been supplanted by the Welsbach mantles. After a metal filament is squirted it must hold together until it is heated to a temperature high enough to sinter the particles together and make the filament into a sort of wire. Obviously it must be difficult to make very fine filaments in this way; and very fine filaments are necessary for reasonably high pressures. If the agglutinant is carbon there is a chance of its being taken up by the metal, and either making the carbide or reducing the melting point, just as carbon reduces the melting point of iron or manganese.

Squirting a mixture of oxide and carbon and then electrically heating to get metal does not look promising because the resulting filament will probably contain carbon, or be a carbide, or else the metal will be only a sort of framework, as the volume of the metal must be less than the volume of the oxide, plus enough carbon to reduce it. Such a filament will have a large diameter for a given weight of metal, and will most likely be very weak.

It may often be easier to squirt a very fine filament of pure oxide than of metal powder. The oxide can then be reduced, in many cases in hydrogen or even carbon monoxide, without forming carbide. In some cases I have found very fine "impalpable" powders can be made by calcining such salts as the oxalates. Prolonged kneading has a marked effect on the extrudibility of many pastes. A paste is much improved by being worked for hours in a small Pfleiderer, or by more powerful kneading. The attrition of the particles seem to grind their corners off.

A filament made by reducing a paste of oxide with hydrogen is also more likely to be dense and strong than one which had the reducing material in its body in addition.

The method of making a squirted filament of oxide and reducing it by running it as a Nernst lamp *in vacuo* is troublesome, and does not give much promise of supplying long, thin filaments. If you consider the length and diameter of the Nernst rod for 100 volts, and compare it with a tantalum wire for the same pressure, it is evident that the method is almost hopeless. A wire the length of a tantalum lamp filament and approximately of the same diameter could not be made of oxide, and could not be run as a Nernst filament with any reasonable pressure if made.

Though metal filaments have been referred to so far, it must be remembered that there is no reason to limit the possible conductors to elements. To begin with, we have the first of the new lamps, the Nernst, made of oxides. The stick of oxides, or glower, as it is generally called, has such a high specific resistance that it need not be long and thin to meet ordinary conditions. On the other hand, the rods cannot be made very thin, as the oxide is soft when hot, and is fragile when cold. The smallest rods made are for 0·25 ampere. On 100 volts these give about 16 candles. The makers do not make rods to take 0·125 ampere so as to give 16 candles on 200 volts. As the lamp requires a heater to start it, and an electro-magnet to put the heater out of circuit, and a series resistance, or "ballast," it has always appeared to me that the real field for the Nernst is not in competition with the 16-candle carbon incandescent, but in the region of 50 to 500 candles. The proportion of cost of the electro-magnet, the resistance, and the heater is smaller in this case, and there is a more open field in competition with small arcs and Welsbach mantles.

The Nernst glowers used to be a mixture, of yttria, or "yttrite earth" with zirconia, and it is probable the same or a similar mixture is still used. There may be a very large field for improvement here. The conditions are that the rod should stand a high temperature without getting too soft, and it should begin to conduct at a low temperature, so that starting should be easy. On the other hand, the lamp is of course patented, so there is not much encouragement for workers making improvements. It may be thought, however, that it would be better to employ some black substance, such as some oxides or sulphides which conduct even cold, so that preliminary heating might be omitted. It is a very curious thing that there does not seem to be any such black or coloured compound in existence.

It may be supposed that a Nernst glower should be run *in vacuo*, so as to avoid the loss by convection. The glower appears to conduct electrolytically exactly in the manner of a fused salt; and it would further appear that with a direct current you would get oxygen at one terminal and zirconium at the other, and that in a few minutes the glower would be entirely reduced to zirconium if the oxygen were pumped out as liberated. What really happens is that the lamp goes out. It does the same in an atmosphere of coal gas. This may be because the zirconium is liberated in a modification which does not conduct.

Zirconium is said to fuse fairly easily; on the other hand, people are said to make lamps of it. As a matter of fact, it is not easy to get such a metal as zirconium pure, and it is quite possible the melting point is very high, and that some particular alloy that was really being examined melted more readily. Nearly all the melting points of such metals are uncertain. Zirconium lamps are made for up to 110 volts at 1 c.p.w.

Tantalum is an exceedingly hard metal, and in its pure state is ductile. It has a specific resistance of 16·5 microhm centimetres cold, or about 85 at the temperature of a lamp. It has a high tensile strength, namely, 93 kg. per sq. mm., or 59 tons per sq. in.

It is drawn into wires of 0·05 down to 0·035 mm.; the large wire gives 25-c.p. lamps on 110 volts. Such a lamp has a filament 65 cm., or 25½ in. long, and a pound of tantalum will make 20,000 of these lamps (Böhm). The tantalum is melted in an electric arc or furnace, and the ingots are heated red, and hammered into sheet, and the sheet is drawn down into wire. Messrs. Siemens and Halske intend to make various uses of the marvellous properties of tantalum, and we shall probably soon have tantalum pens, drills, cutting tools, unoxidisable springs, and other desirable objects.

Messrs. Siemens & Halske do not recommend their lamp for alternating currents, and it cannot therefore be as good as on direct-current circuits; but it runs on alternating currents very well though perhaps not as long. On the other hand, it is said that the alternating current alters the physical nature of the wire, rendering it brittle, so that it breaks, not by fatigue, but by any slight shock it happens to get. The Nernst lamp has shown peculiarities in this connection. Some glowers will run with direct and not with alternating currents, and some with alternating only. Direct-current glowers also go wrong if the poles are changed. These mysterious properties of the Nernst do not seem to have anything to do with the behaviour of the tantalum lamp, however, but all the same there may be something in common. It is said that the makers have now overcome the aversion of tantalum lamps to alternating circuits. I have heard of tantalum lamps running on the County of London alternating circuits for over 600 hours with no failures. The makers attribute the breakages to the trembling action due to the repulsion of the wire near the bends. This will most likely be overcome by making the zigs and the zags so that the wire does not come close to itself. At present they are very acute angles. The wires are often in movement through a sort of Trevelyan rocker effect at the points of contact of the wire with its numerous supports.

Molybdenum is very similar to tungsten, and unless the melting point is lower than that of tungsten, we shall probably soon have molybdenum lamps. The trioxide (the anhydride of molybdic acid) is volatile, and might therefore be used for deposition of molybdenum on a carbon filament, so as to replace it.

Tungsten is a very hard and brittle metal, which is sold in the form of a black powder, or as ferrotungsten. It was for a long time considered infusible, but the electrical furnace showed, of course, that it could be melted. The powder is difficult to squirt, even mixed with a good deal of tragacanth. Kuzel has invented what seems to be an admirable way of getting over the difficulty. He gets the tungsten in the form of an exceedingly fine powder by employing a method that was used by Bredig for getting what is known as colloidal platinum. An arc is made to play under water between tungsten electrodes, and this is said to produce a very finely divided form of metal. This is collected and worked up into a stiff enough paste and squirted. Tungsten is not an expensive metal, so the only cost is in making the filaments. Whether the filaments of this paste can be squirted so as to be fine enough for 200 volts will be a matter for the future to decide.

There have been processes proposed or worked in which carbon is heated in a vapour of a volatile tungsten compound, such as the trichloride, or oxychloride, in the presence of hydrogen. If the reduction in the case of a chloride is due to the hydrogen, thus involving no oxidation of the carbon, a filament must be obtained of carbon coated with tungsten, or of carbide of tungsten; but if there is any oxygen involved in the reduction, as in the case of the oxychloride, the carbon is burnt out, and the result is a filament of tungsten.

Osmium is a crystalline metal, which cannot be drawn into wire. It is very hard, scratching quartz. The Welsbach osmium lamp is said to be made by making a paste of finely divided osmium and an organic binding material, and squirting it. The filaments are then baked, and heated electrically to a very high temperature to eliminate the carbon. The osmium lamp so far produced is for low pressures, as might be expected, but it has a very high efficiency.

Making lamps of osmium must be an exceedingly difficult matter. Apart from the metal being very hard and infusible, it oxidises in the air if very fine, though this oxidation does not take place if the fine powder has been heated to a high temperature. The peroxide of osmium formed is very poisonous. It gives off enough vapour at ordinary temperatures to give much trouble, and especially to injure the eyes very seriously. This oxide might be used for replacing a carbon filament with osmium. No doubt that has been tried. The osmium was, I think, the first of the new metal lamps, and was invented by Auer von Welsbach. It is made up to 75 volts with 40 candles by the Vienna firm, now the Westinghouse-Metallfaden-Glühlampfabrik, but 100-130-volt lamps of only 32 candles are supplied by the General Electric Co., of this country. The rated efficiency is 0·8 c.p.w.

The osmium wire is said to be as small as 0·03 mm. diameter, which is rather less than the finer tantalum wire.

There is some doubt whether the lamps known as osmium are made of osmium or an alloy of osmium or tungsten. Tungsten is a curious metal, and it is not very easy to get into alloys, but it may alloy with osmium perfectly for all I know to the contrary.

Iridium is a very hard and brittle metal. Iridium lamps are being studied by Gülcher. He makes a paste with an organic binding material, and squirts it. The filaments are then heated electrically until the carbon is burnt out, and some particles of metal have sintered together. This lamp, like other metal lamps, labours under the disadvantage of being only for low pressures. It would seem that squirted metal filaments are less likely to be made fine than those made from drawn wire.

It will be asked, What will be the effect of these new lamps on the industry? In the first place, they will increase the output of stations, just as machinery increases labour. But there is more difficulty in foreseeing the result of high efficiency hampered with low pressure. A probable solution is that people will gradually take to using large lamps taking the same pressure, and about the same power as carbon lamps, but giving, say, four times the light.

As to the lamp-making industry, one might prophesy without much danger that the present makers will merely alter their manufacture and make metal lamps. This will pay inventors better, because the existing makers have their commercial organisations and their facilities for distribution. Besides, all the works except the parts devoted to making the filaments will be available. It is possible new works will be set up to make filaments, and that the lamp-makers will buy the filaments and make them up into lamps. There are so many possible ways of making metal filaments, that it is doubtful whether large monopolies can be secured by patents; and it is much more likely that most of the present carbon lamp makers will work out particular processes of their own, and will put their own metal lamps in the market.

DISCUSSION.

The discussion was opened by Dr. J. A. HARKER, who mentioned that he had been accumulating data as to the melting points of metals. It was only within the past six years that these temperatures had been known at all definitely; by comparison with that of platinum other melting points could be ascertained. The melting point of platinum, determined by the National Physical Laboratory and confirmed in Germany, was 1,710° C. (some doubt was, however, cast on the accuracy of this figure at the conclusion of the discussion). A table of melting points was exhibited by Dr. Harker, who mentioned that boron and carbon did not melt but volatilised; titanium's melting point at 2,500° C. was approximately correct, as also was zirconium's at 1,300° C.; many of the others were uncertain. He asked the author if he knew any refractory material which at high temperatures was an insulator; he thought that all refractory materials behaved like Nernst lamps at high temperatures—he had run a bit of clay pipe in that way for a short time. The use of carborundum for incandescent lamps had been patented by Sir Joseph Swan, but he (the speaker) found that it dissociated at high temperatures, the silicon burning out and leaving only carbon behind, a point which he demonstrated experimentally.

Prof. KAPP referred to some experiments on new lamps, from which it appeared that osmium and tantalum lamps each averaged 1·7 watts per C.P. On circuits of varying pressure, however, he obtained varying results, as follows, the results being for a 4 per cent. high and low pressure respectively:—Carbon, light increased 25 per cent., and decreased 20 per cent.; tantalum, light increased 18 per cent. and decreased 12 per cent.; osmium, light increased 22 per cent. and decreased 18 per cent.; the Nernst lamp was rather worse than the carbon, the filament often gave out in raising the pressure 4 per cent., but the lamp gave a bright concentrated light. The tests showed practically the same efficiencies despite the varying temperatures. The limit of temperature of the Nernst lamp was 2,200°-2,400° C.; and of the carbon lamp 1,875°-2,100° C.; the light should vary as the one-third power of the power put into the lamp, and for tantalum and osmium lamps this was nearly true, but for carbon it varied as the two-seventh power. As 1 per cent. more power should give 3 per cent. more light, the fact that the Nernst lamp did not give its due proportion of light for temperature called for some explanation; he thought it was probably due to the preliminary heating and to the ballast resistance absorbing power. From tests, the efficiencies of the various lamps, compared with that of the firefly, appeared to be: Welsbach, ½ per cent.; carbon incandescent, 1·3-1·8 per cent.; tantalum, 2·5 per cent.; ordinary arc, 4·5 per cent.; and flame arc, 10·22 per cent.

Prof. SILVANUS THOMPSON referred to some private experiments at his own house, where there was a 100-volt circuit. He had had four osmium lamps running some 18 months with perfect success; of six tantalum lamps under similar conditions, only two were still intact. Microscopic examination of the broken filaments of carbon and tantalum lamps revealed an astonishing difference between the two; the former were good cylindrical threads, but the latter were composed of a number of badly jointed, irregular cylindrical sections. The Professor exhibited both specimens and lantern slides of the various filaments.

Prof. FLEMING considered that the paper showed the importance of chemistry in electrical matters; both the tantalum and the Nernst lamps were due to chemists. He touched on the mathematical relation between current, pressure and candle-power, pointing out that the candle-power varied roughly as the sixth power of the current. The discharge which occurred between the legs of a carbon filament did not take place in the case of metallic filaments.

Mr. M. SOLOMON thought the prospects for metallic filaments were not so rosy as appeared at first sight; carbon was the most suitable material for filaments, it had a high melting point and high specific resistance, not found with other materials. He considered that high candle-power was not wanted.

Mr. H. HIRST, speaking for the lamp makers, vindicated their enterprise. He pointed out that German scientists had developed most of the lamps on the market, and although we had equally good men here, they spent their time in giving expert evidence rather than in helping the manufacturer.

Mr. H. D. MUNRO (Exeter) referred to his experience with some 2,000 Osram lamps on the Exeter circuits. These had proved very successful both for private and public lighting, in the latter case on tramway standards, where they were exposed to vibration.

Mr. V. H. MACKINNEY referred to tests which he had made and which showed that whereas the tantalum lamp showed a 17 per cent. drop in efficiency after 1000 hours, the Osmi lamp showed a slight increase in efficiency.

Dr. D. K. MORRIS based his remarks on the following table, which he had compiled from tests recently carried out:—

Type of lamp.	R. —	R. Oscillograph.	V.	W.
Carbon (ordinary)	·55	·53	6·5	3·1
Tantalum, 22-C.P. 110 V. ...	6·3	4·6	4·3	2·5
Osmium, 25-C.P. 55 V. ...	7·9	—	4·6	2·7
Zircon, 31-C.P. 110 V. ...	8·9	6·0	4·0	2·5
Wolfram, 35-C.P. 110 V. ...	11·4 12·8	11·5	2·9	2·2
Osram 28-C.P. 107 V. ...	8·5 8·7	6·7		
Osram 44-C.P. 105 V. ...	12·9	7·2	4·0	2·5

The first column shows the change of resistance between the hot and cold lamps; a result of this was increased energy consumption at starting. In the case of the wolfram (tungsten) lamp, the current fell in $\frac{1}{10}$th second to its normal value. The last two columns are an index to the volts and watts.

Mr. LEON GASTER showed some Zircon-Wolfram lamps, one of which was running on a 200-volt circuit and giving one candle per watt; these lamps are suitable for either direct or alternating current. Frequency, in the case of alternating circuits, had, he considered, a direct effect on the life of some metallic filaments; when as low as 25 cycles they were all right, but above 50 cycles the filament's life greatly decreased. The high frequency aided crystallisation.

Mr. H. M. SAYERS remarked on the peculiar structure of tantalum filaments which had failed.

Mr. HAYDN HARRISON was convinced that the new lamps would be very largely used where suitable circuits existed, and authorities possessing such circuits (as at Exeter) would derive the immediate benefit.

Mr. C. C. PATERSON showed some interesting slides relating to tests of the Nernst lamp, made at the National Physical Laboratory, which we hope to reproduce shortly.

Mr. SWINBURNE briefly replied to the discussion. He thought that the action of silicon carbide in burning in air, as shown by Dr. Harker, was no index to its behaviour in a vacuum. With reference to Mr. Hirst's defence of the lamp manufacturer, he mentioned that his own opinion was based on information obtained from other sources.

The meeting closed with a vote of thanks to the author.

Electric Locomotives for Mines. — The Elektromontana Gesellschaft, of Berlin and Essen, is the title of a new company which has been constituted by the Accumulator Works Co., of Berlin, the Company for Electrical Enterprises of Berlin, and the Rhenish-Westphalian Electricity Works Co., of Essen. As objects of the new company are cited the supply of mining locomotives for secondary battery working, shaft and road lighting by means of accumulator cars, and the manufacture and delivery of electric mining lamps. The company has acquired the patents held in these respects by the Accumulator Works Co. and the Company for Electrical Enterprises.

Underground Letter Carriers.—It is now quite a number of years since a proposal was brought before the British Association for the establishment in large cities of an underground network of tubes of small diameter, containing rails for the accommodation of electric trucks or carriers for the transport of sacks of letters and small parcels between different post offices, and also between post offices and other places—such as railway stations. The idea was again brought forward two or three years ago by a company which promoted a Bill in Parliament to authorise the construction of a series of miniature underground electric railways for the same purpose in London, but the scheme failed to mature. Now a similar project has been advanced in the German capital by the Berlin Post Office authorities, who have placed details before the Highways Committee of the Municipal Council. It appears from a report of the proceedings of the Committee, on January 15th, that the scheme contemplates the construction of underground tunnels between the General Post Office in the Heiligengeist Strasse and the various railway stations. The tracks to be laid in the tunnels will serve for the use of small electric locomotives with trailers for carrying sacks of letters to and fro. It is proposed by way of a beginning to construct such a line between the General Post Office and the Potsdamer railway station. The scheme will be difficult of execution, as not only have two water-courses—the Spree and the Schleusen canal—to be crossed, but also four underground railways. After consideration the Municipal Highways Committee have decided not to place any obstacles in the way of the realisation of the project, in so far as the underground pipes, &c., of the town are not prejudiced by the manner in which use is proposed to be made of the sub-soil of the streets.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

353. "Improvements in apparatus for pumping milk, chemical, electrolytic or corrosive solutions." F. J. CLARKE. January 7th.

369. "Safety device for exposed electric conductors." R. F. HAMILTON. January 7th.

383. "Improvements in electrically-controlled switch-operating mechanism for railways." K. W. G. J. STOFFELS. January 7th. (Complete.)

393. "Improved method of testing leakage from electrical circuits." A. D. STEVENSON. January 7th.

414. "Metallurgical and electro-metallurgical process for production of pure copper." L. JUMAU. (Date applied for under Patents Act, 1901, March 30th, 1906, being date of application in France.) January 7th. (Complete.)

436. "Improvements in or relating to surface contact electric traction systems." E. A. MITCHELL. January 7th.

440. "Improvements in methods of regulating alternating current electric motors of the commutator type." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts Ges., Germany.) January 7th.

441. "Improvements in and relating to dynamo-electric machines having commutating poles." THE BRITISH THOMSON-HOUSTON CO., LTD. January 7th.

449. "New or improved electrical signalling apparatus." W. W. LOVETT. January 7th.

453. "Improvements in controllers for the trolley poles of electric cars." A. J. EDWARDS. January 7th.

455. "Electrical heating apparatus." W. E. TRUMPLER. January 7th. (Complete.)

494. "Improvements in current collecting devices for electrical apparatus." T. VARNEY. (Date applied for under Patents Act, 1901, January 16th, 1906, being date of application in United States.) January 8th. (Complete.)

498. "Improvements in or relating to dynamo brushes." The firm of P. RINGSDORFF. (Date applied for under Patents Act, 1901, January 11th, 1906, being date of application in Germany.) January 8th. (Complete.)

502. "Improvements in and relating to the electrical transmission of time." G. H. R. M. DE PEYRECAVE and L. F. M. DE PEYRECAVE. January 8th. (Complete.)

504. "Electro-magnetic motor." G. D. LEY. January 8th.

517. "Improvements in electric accumulator and other cells." H. LEITNER. January 8th.

521. "Improvements in inclined carbon arc lamps." E. PEARCE and S. WALTON. January 8th.

522. "Improved clip for fixing conducting wires to insulators." S. R. VON SONNENTHAL. January 8th. (Complete.)

523. "Improvements in and connected with electro-capillary apparatus." THE CAPILLIFORM TELEGRAPH INSTRUMENT CO., LTD., and E. A. GODDIN. January 8th.

539. "Improvements relating to the production of alternating electric currents." E. RUHMER. January 8th. (Complete.)

692. "Improvements in and relating to electric switches." F. H. SMITH. January 10th.

693. "Improvements in and relating to ignition devices for internal combustion motors." F. H. SMITH. January 10th.

706. "Improvements in electric railroad signals." A. W. MCMAUGH and R. WELCH. January 10th. (Complete.)

725. "Improvements in electric measuring instruments." F. H. NALDER and NALDER BROS. & THOMPSON, LTD. January 10th.

726. "Improvements in electric contacts." BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts-Ges, Germany). January 11th.

727. "Improvements in dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., U.S.). January 11th.

762. "Improved brake arrangements for electric tramcar and similar vehicles." F. TOLKIEN. January 11th.

774. "Improvements in and relating to electric motor-generators and other dynamo-electric machines." CROMPTON & CO., LTD., J. C. MACFARLANE and H. BURGE. January 11th.

776. "Improvement in electric lampholders." J. A. GOSLING. January 11th.

783. "Improvements in or relating to covering, arranging and mounting electric conductors." G. CALVERT. January 11th.

785. "Improvements in apparatus for indicating or recording vibrations or oscillations and for controlling electric circuits correspondingly with such movements." W. BRAY. January 11th.

543. "Improvements relating to electric cut-outs and the like." AKTIEN-GESELLSCHAFT BROWN, BOVERI & CIE. (Date applied for under Patents Act, 1901, May 2nd, 1906, being date of application in Germany). January 8th. (Complete.)

555. "Improvements in or connected with electric switches." T. CLARK and I. VLASTO. January 9th.

565. "Improvements in or in connection with the trolley ropes of electric tramcar and like vehicles." F. MORELAND. January 9th.

585. "Process for producing incandescent filaments for electrical lamps and arc light electrodes." H. RUBERT. January 9th. (Complete.)

586. "Improvements in or relating to the control of electrically-propelled vehicles." J. S. RAWORTH and A. RAWORTH. January 9th. (Complete.)

596. "Improvements in electric furnaces." S. O. COWPER-COLES. January 9th. (Complete.)

615. "Improvements in and relating to electric safety lamps for use in mines." A. D. J. MALLET. January 9th. (Complete.)

633. "Improvements relating to alternating-current commutating electric machines." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Patents Act, 1901, January 29th, 1906, being date of application in Germany.) January 9th. (Complete.)

634. "Improvements in and relating to electric distribution systems." THE BRITISH THOMSON-HOUSTON CO., LTD., and E. B. WEDMORE. January 9th.

637. "Electric bridge hand signal lamp." E. H. EVENS. January 9th.

640. "Improvements in liquid electrical controllers." H. RICHARDSON, C. F. COOKE and SOUTH DURHAM STEEL AND IRON CO., LTD. January 10th.

686. "Improvements in or relating to electric batteries." A. H. COOTE. January 10th.

798. "Improved automatic electric motor starter." W. D. KILROY and EVERSHED & VIGNOLES, LTD. January 11th.

814. "Improvements in or relating to incandescent electric lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts-Gesellschaft, Germany.) January 11th.

835. "Improvements in the manufacture of electric incandescent lamps." O. SCHOTT. January 12th.

865. "Improvements in electro-magnetic brakes for railway and like vehicles." W. SCHAAKE. January 12th.

880. "Improvements in dynamo-electric machines or variable speed motors." J. C. LINCOLN. (Date applied for under Patents Act, 1901, January 12th, 1906, being date of application in the United States.) January 12th. (Complete.)

887. "Improvements in receivers for wireless telegraphy." G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. January 12th.

888. "Improvements in apparatus for producing alternating electric currents." G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. January 12th.

899. "Improvements in or relating to magnetic separators." W. J. HOLLIDGE. January 12th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ARRANGEMENT FOR THE REGULATION OF SPEED OF COMPENSATED SINGLE-PHASE MOTORS. E. Arnold. 23,661. November 17th. (Date applied for under International Convention, November 21st, 1904.)

SPRING CONTROLLED DEVICE FOR RAISING AND LOWERING ELECTRIC LAMPS. W. Vernum. 26,219. December 16th.

ELECTRO-MAGNETIC DEVICES FOR USE ON ALTERNATING CURRENT CIRCUITS. M. B. Field and Ferranti, Ltd. 26,281. December 16th.

CONTACT BREAKERS FOR USE WITH IGNITION DEVICES FOR INTERNAL COMBUSTION ENGINES AND THE LIKE. E. F. Bradley. 26,726. December 21st.

IGNITION DEVICES FOR INTERNAL COMBUSTION ENGINES AND THE LIKE. E. F. Bradley. 26,727. December 21st.

ALTERNATING CURRENT ELECTRIC MOTORS. R. Lundell. 26,808. December 22nd.

SWIVELLING CONTACTS FOR THE TROLLEY STANDARDS OF ELECTRIC TRAMCARS AND THE LIKE. M. B. Mountain and G. M. Gibson. 27,057. December 28th.

TROLLEY POLE STANDARDS OF ELECTRIC TRAMCARS AND THE LIKE. M. B. Mountain and G. M. Gibson. 27,059. December 28th.

1906.

OPERATION OF VAPOUR-ELECTRIC LAMPS. P. H. Thomas. 20,730. September 18th. (Date applied for under International Convention, September 27th, 1905.)

ELECTRIC BATTERIES. H. W. van Raden and C. B. Robinson. 21,472. September 22nd.

MEANS FOR NEUTRALISING STATIC ELECTRICITY IN YARN, PAPER, AND OTHER MATERIALS. W. H. Chapman. 23,548.

ELECTRIC METERS. British Thomson-Houston Co. and A. J. Martin. 1,115. January 15th.

PROTECTING CAPS FOR THE ELECTRODES OF SPARKING PLUGS FOR INTERNAL COMBUSTION ENGINES. J. Aldigier. 1,783. January 24th.

ELECTRICAL SPARKING OR IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES. A. Westmacott and W. F. Thomas. 1,847. January 24th.

HIGH TENSION DIRECT CURRENT ELECTRIC SYSTEMS. J. S. Highfield. 1,946. January 25th.

SYSTEMS OF DIRECT CURRENT ELECTRIC SUPPLY. J. S. Highfield. 1,947. January 25th.

ELECTRIC HEATING DEVICES. British Thomson-Houston Co. (General Electric Co.) 2,792. February 5th.

ELECTRIC MAKE AND BREAK SWITCHES. G. H. Baillie. 3,028. February 8th.

ELECTRIC FUSIBLE CUT-OUTS. O. L. Peard. 3,783. February 15th.

SYSTEMS OF ELECTRIC MOTOR CONTROL. British Thomson-Houston Co. (General Electric Co.) 4,514. February 23rd.

WIRELESS TELEPHONY AND TELEGRAPHY. A. F. Collins. 4,691. February 26th.

ELECTRO-MAGNETIC FITTING MECHANISM FOR RECOILING BREECH-LOADING GUNS. A. T. Dawson and G. T. Buckham. 5,957. March 12th.

PROTECTIVE DEVICES FOR VAPOUR-ELECTRIC APPARATUS. British Thomson-Houston Co. (General Electric Co.) 6,818. March 21st.

VAPOUR-ELECTRIC APPARATUS. British Thomson-Houston Co. (General Electric Co.) 7,413. March 27th.

ELECTRIC LIGHT FITTINGS. S. B. Marshall. 7,626. March 29th.

MANUFACTURE OF TUNGSTEN FILAMENTS FOR INCANDESCENCE ELECTRIC LAMPS. A. G. Bloxam. (J. Lux.) 7,803. March 31st.

MICROPHONES. G. Angelini. 8,168. April 4th.

MEANS FOR THE PRODUCTION OF LONG STABLE ELECTRIC ARCS. J. Y. Johnson. (Badische Anilin und Soda Fabrik.) 9,279. April 19th.

SPACE TELEGRAPHY. J. S. Stone. 9,422. April 21st. (Date applied for under International Convention, May 10th, 1905.)

ELECTRIC FURNACES. H. L. Hartenstein. 10,156. May 1st.

VAPOUR-ELECTRIC APPARATUS. P. H. Thomas. 10,957. May 10th. (Date applied for under International Convention, May 11th, 1905.)

The Situation of German Trade.—A report on the present condition of the German electrical engineering industry states that business continues to develop in a favourable manner. On all hands a strong demand for manufactures has been maintained down to the present time, and the orders received are still very considerable, so that the capacity of the works is being largely taxed to meet requirements. Nevertheless, some concern is manifested in leading electrical circles at the enormous rise in the cost of raw materials, which has led to the increase in the prices of manufactures. It is feared under existing conditions of prices that the large power stations may withhold orders for their needs in the matter of cables, and that a less favourable movement may be produced in this direction. But for the present there is in general no question of thinking of a decline in business in so far as may be judged from the activity prevailing in the coal and iron and steel industry, especially in Rhenish-Westphalia, and from the numerous electrical schemes pending in the latter province. The situation of the money market has hitherto not exercised an unfavourable influence directly upon the electrical industry. The formation of new electrical companies, which practically came to a standstill for two or three years, was succeeded by activity of some extent during 1906. Altogether eight concerns were constituted with a united capital of £758,500, the principal undertakings being the Neckar Works and the Mark Works in Westphalia.